COURSE SYLLABUS
CURRICULUM 2023-2027

STUDY PROGRAM : UNDERGRADUATE (S1)
DEPARTMENT :GEOPHYSICAL ENGINEERING

FACULTY OF CIVIL PLANNING AND GEO ENGINEERING
INSTITUT TEKNOLOGI SEPULUH NOPEMBER
2023

DOCUMENT

COURSE SYLLABUS-CURRICULUM 2023-2028
UNDERGRADUATE STUDY PROGRAM (S1)
GEOPHYSICAL ENGINEERING DEPARTMENT

Surabaya, Februari 28 2023

Team Leader : **Wien Lestari, S.T., M.T.**
Employee ID : **19811002 201212 2 003**
Study Program : **Undergraduate (S1) Geophysical Engineering**
Faculty : **Civil Planning and Geo Engineering**

INSTITUT TEKNOLOGI SEPULUH NOPEMBER, Tahun 2023

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER Kampus ITS, Jl. Raya ITS, Keputih Sikolilo, Surabaya, 60111 Phone (031) 5994251 URL www.its.ac.id	**Number:** **2.3.2.3.3.6.1**
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Process	Person In Charge			Date
	Name	Position	Signature	
Formulator	Wien Lestari, S.T., M.T.	Leader of Study Program Curriculum		Januari 02 2023
Examiner	Dr. Dwa Desa Warnana	Head of Study Program		July 01 2023
Approval	Dr. Dwa Desa Warnana	Head of Department		August 01 2023
Assignment	Dr. Murni Rachmawati	Dean of Faculty of Civil Planning and Geo Engineering		August 03 2023
Control	Wien Lestari, S.T., M.T.	Head of Department Quality Assurance		August 11 2023

Examination and review of the 2023-2028 Curriculum Course Syllabus has been carried out on the following:
1. Course Codes and Credits
2. Course Description
3. Suitability of Program Learning Outcomes (CPL) to CPMK and sub-CPMK
4. Study Materials
5. References

Process	Person In Charge			Date
	Name	Position	Signature	
Formulator	Wien Lestari, S.T., M.T.	Leader of Study Program Curriculum		Januari 02 2023
Examiner	Dr. Dwa Desa Warnana	Head of Study Program		October 02 2023
Approval	Dr. Dwa Desa Warnana	Head of Department		October 20 2023

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
COURSE	**Course Name**	**Calculus 1**
	Course Code	**SM224101**
	Credit (SKS)	**3 (Three)**
	Semester	**1 (One)**

COURSE DESCRIPTION

In this course, students will learn the following subjects:

1. Basic concept of real number system: definition of real number system, decimal form of real number, coordinate system, nature of sequence, definition of absolute value, graph of linear equations.
2. The basic concept of complex numbers: addition, multiplication, quotient, polar form of complex numbers and their algebraic operations and the drawing of equations in complex number systems.
3. The basic concepts of matrix algebra, determinant properties, elementary line operations, systems of linear equations and the problem of eigenvalues or eigenvectors.
4. The concepts of function, limit: domain, range, linear, quadratic and trigonometric or transcendent function, function graph, limit function and continuity.
5. Differential / derivative: definition of derivatives, referenced rules (for polynomial, trigonometric, tramcendent functions), chain rules and implicit derivatives of functions.
6. Derivative Applications: corresponding rates, increment interval, slope, graph sketch having asymptotes and peaks, extreme values and application of optimization problems.

Indefinite integrals: Derivatives and anti-derivatives, Fundamental Theorems of Calculus.

PROGRAM LEARNING OUTCOMES (PLO)	
PLO-2	Able to study and utilize science and technology in order to apply it to mathematical knowledge and be able to make appropriate decisions from the results of their own work or group work in the form of final project reports or other forms of learning activities whose outcomes are equivalent to final assignments through logical, critical thinking, systematic and innovative.
COURSE LEARNING OUTCOMES (CLO)	
CLO-1	Students are able to apply equalities or inequalities as well as graphs of linear equation functions.
CLO-2	Students are able to apply complex variable forms in polar forms and get the roots of the equation.
CLO-3	Students are able to apply matrix concepts to solve a linear equation system and determine the eigenvalues.
CLO-4	Students are able to determine the continuity of functions and their derivatives.
CLO-5	Students are able to apply integrals through the fundamental theorem of calculus.
SUB COURSE LEARNING OUTCOMES (SUB CLO)	
Sub CLO-1	Students are able to apply equalities or inequalities as well as graphs of linear equation functions.
Sub CLO-2	Students are able to apply complex variable forms in polar forms and get the roots of the equation.
Sub CLO-3	Students are able to apply matrix concepts to solve a linear equation system and determine the eigenvalues.

Sub CLO-4	Students are able to determine the continuity of functions and their derivatives.
Sub CLO-5	Students are able to apply integrals through the fundamental theorem of calculus.

STUDY MATERIALS

- Matrix and Determinant. / Matrix and Determinants
- Equations, inequalities, graphs of functions of a parabola, circle or ellipse./ Equations, inequalities, graphs of functions of a parabola, circle or ellipse
- Complex numbers and their polar forms./ Complex numbers and their polar coordinates.
- Continuity of function and its derivatives. / Continuity of functions and their derivatives.
- Integrals and the Fundamental Theorem of Calculus. / Integral and Fundamental Theorems of Calculus.

PRECONDITION

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REFERENCES

1. ITS Mathematics Department Lecturer Team, Mathematics Diktat 1, 5th Edition ITS Mathematics Department, 2020
2. Anton, H. et al, Calculus, 10-th edition, John Wiley & Sons, New York, 2012
3. Kreyzig, E, Advanced Engineering Mathematics, 10-th edition, John Wiley & Sons, Singapore, 2011
4. Purcell, J, E, Rigdon, S., E., Calculus, 9-th edition, Prentice-Hall, New Jersey, 2006
5. James Stewart ,*Calculus*, 7th ed., Brooks/cole-Cengage Learning, Canada,2012

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
COURSE	**Course Name**	**Mechanics Physics**
	Course Code	**SF234102**
	Credit (SKS)	**4 (Four)**
	Semester	**1 (One)**
COURSE DESCRIPTION		
In this course students will learn to understand the basic laws of physics, particle kinematics; Particle dynamics; Work and energy; rotational motion; Vibration and fluid mechanics, through simple mathematical explanations as well as introducing examples of concept use, and analyzing the material in the form of practical work. The practicum includes: (1) Physical pendulum, (2) Mathematical pendulum, (3) Spring constant, (4) Liquid viscosity, (5) Bullet motion, (6) Coefficient of friction, (7) Moment of inertia.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-2	Able to study and utilize science and technology in order to apply it to physics knowledge, as well as being able to make appropriate decisions from the results of one's own work or group work in the form of final assignment reports or other forms of learning activities whose output is equivalent to the final assignment through logical, critical thinking, systematic and innovative.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to apply vector concepts in kinematics and dynamics of particle motion and particle system motion to solve one, two, and three dimensional motion. Understand and be able to apply the concept of work-energy in solving mechanical problems	
CLO-2	Able to formulate, solve and analyze static and dynamic problems of rigid body systems. Understand and be able to solve vibration problems.	
CLO-3	Understand and be able to solve fluid statics (hydrostatics) and fluid dynamics problems	
CLO-4	Able to apply the concept of physics I material through practicum activities in the laboratory, analyzing data, and presenting experimental results in the form of a practicum report.	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	Able to apply vector concepts in kinematics and dynamics of particle motion and particle system motion to solve one, two, and three dimensional motion. Understand and be able to apply the concept of work-energy in solving mechanical problems	
Sub CLO-2	Able to formulate, solve and analyze static and dynamic problems of rigid body systems. Understand and be able to solve vibration problems.	
Sub CLO-3	Understand and be able to solve fluid statics (hydrostatics) and fluid dynamics problems	
Sub CLO-4	Able to apply the concept of physics I material through practicum activities in the laboratory, analyzing data, and presenting experimental results in the form of a practicum report.	
Sub CLO-5	Able to apply vector concepts in kinematics and dynamics of particle motion and particle system motion to solve one, two, and three	

	dimensional motion. Understand and be able to apply the concept of work-energy in solving mechanical problems
Sub CLO-6	Able to formulate, solve and analyze static and dynamic problems of rigid body systems. Understand and be able to solve vibration problems.
Sub CLO-7	Understand and be able to solve fluid statics (hydrostatics) and fluid dynamics problems

STUDY MATERIALS

Quantities and vectors: Basic quantities, derived quantities, units, unit conversion, scalar and vector quantities, mathematical operations on vectors geometrically and analytically
Particle kinematics: Shifting position, speed, acceleration, straight motion, curved motion (parabola and circular); relative motion.
Particle dynamics: Newton's Laws I, II and III, various forces (gravitational force, weight force, rope tension force, normal force, friction force and spring force), balance of forces, application of Newton's laws I, II and III;
Work and energy: work concept, kinetic energy, potential energy (gravity and spring), work energy theorem, law of conservation of mechanical energy,
Impulse and Momentum: impulse, momentum, collision (elastic and inelastic),;
Rotation dynamics: Angular displacement, angular velocity and angular acceleration, moment of force (torque), center of mass, equilibrium moment of force, moment of inertia, rotational kinetic energy, rolling motion, law of conservation of energy (translation and rotation)
Vibration: simple harmonic motion, simple harmonic motion energy, mathematical pendulum, physical pendulum, torsion pendulum, combination of harmonic vibrations (parallel and perpendicular);
Fluid mechanics: hydrostatic pressure, Pascal's principle, Archimedes' principle, surface tension, continuity equation, Bernoulli's equation, viscosity.

PRECONDITION

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REFERENCES

1. Sears & Zemanky,"University Physics", Pearson Education, 14thed, USA, 2016
2. Douglas C. Giancoli, 'Physics for Scientists and Engineers, Pearson Education, 4th ed, London, 2014
3. Lecturer Team, "Physics I", Physics FMIPA-ITS
4. "Basic Physics Practicum Instructions", Physics, MIPA-ITS
5. Halliday, Resnic, Jearl Walker; 'Fundamentals of Physics'. John Wiley and Sons, 10th ed, New York, 2014
6. Tipler, PA, 'Physics for Scientists and Engineers', 6th ed., WH Freeman and Co., New York, 2008

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Course	**Course Name**	**Physical Geophysics**
	Course Code	**CF234101**
	Credit (SKS)	**3 (Three)**
	Semester	**1 (One)**
COURSE DESCRIPTION		
This course explains the definition of geology, physical geology and dynamic geology; the origin of the earth, the physical properties of the earth, the relationship between geology and other scientific disciplines, the basic laws of geology, the earth's constituent materials, geological processes in the lithosphere and its results, the earth as a dynamic system, an introduction to plate tectonics which includes the basic understanding of active tectonics, formation of mountains and volcanoes, geochronology and applied geology. The course applies the case learning method.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-4	Able to explain the principles of mathematics, natural sciences, geology, geospatial, instrumentation, information technology, engineering principles and designs into geophysical engineering procedures, processes, systems or methodologies.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to explain the concept of endogenic processes and the resulting products	
CLO-2	Able to explain the concept of exogenic processes and the resulting products	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C2,A3] Be able to explain the concept of the interior structure and composition of the earth and the history of its formation	
Sub CLO-2	[C2,A3] Be able to explain the concept of endogenic energy and the resulting landscape	
Sub CLO-3	[C2,A3] Be able to explain geological disasters and geological resources due to endogenic processes	
Sub CLO-4	[C2,A3] Be able to explain the concept of exogenic energy and the resulting landscape	
Sub CLO-5	[C2,A3] Be able to explain geological disasters and geological resources due to exogenic processes	
STUDY MATERIALS		
• Earth structure • Earth composition • Endogenous energy • Plate tectonics • Wilson cycle • Rock cycle • Rock classification • Geological structure • Seismicity and volcanic eruptions • exogenic process • Weathering and erosion • Transport and deposition		

- Landslides and floods
- Fluvial geomorphology
- Coastal and delta geomorphology
- Ocean floor geomorphology
- Karst geomorphology
- Geological resources

PRECONDITION

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REFERENCES

1. Plummer, CC and Carlson, D., 2008, Physical geology : Earth revealed 7th Ed, McGraw-Hill Science
2. Hamblin, WK and Christiansen, EH, 1998. Earth's Dynamic Systems, 8th Ed., Prentice-Hall, Inc., Upper Saddle River, New Jersey.
3. Sanders, JE, 1981, Principles of Physical Geology, John Wiley and Sons Co., Inc., New York.
4. Sawkins, SJ, Chase, CG, Darby, DG, and Rapp, G., 1978. The Evolving Earth, 2nd Ed., Macmillan Publishing Co., Inc., New York.
5. Tarbuck, EJ and Lutgens, FK, 2000. Earth Science, 9th Ed., Prentice-Hall, Inc., Upper Saddle River, New Jersey.
6. Publications about earthscience

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Course	**Course Name**	**Mapping**
	Course Code	**CF234102**
	Credit (SKS)	**2 (Two)**
	Semester	**1 (One)**
COURSE DESCRIPTION		
This course examines geospatial information and its use. Students will study one of the main objectives in science and technology in the field of spatial information and can support Geophysical Engineering work, namely Introduction to Geospatial Information. Through this lecture, students can find out about the science and technology available at the Faculty of Civil, Environmental and Earth Engineering		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-4	Able to explain the principles of mathematics, natural sciences, geology, geospatial, instrumentation, information technology, engineering principles and designs into geophysical engineering procedures, processes, systems or methodologies.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to analyze and interpret spatial data using geospatial information science and technology	
CLO-2	Able to present spatial data using geospatial information science and technology	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C4,P4,A4] Able to explains the concept of cartography, including the meaning of maps, the position of a place and the purpose of cartography	
Sub CLO-2	[C4, P4, A4] Able to explain simple map making procedures	
Sub CLO-3	[C4, P3, A3] Able to design simple map layouts	
Sub CLO-4	[C4,P3,A3] Be able to make a map from a series of available data (secondary data)	
STUDY MATERIALS		
Basic geospatial concepts can support the work of Civil Engineering, Environmental Engineering, Geomatics Engineering and Geophysical Engineering		
PRECONDITION		
Introduction to Geospatial Information		
REFERENCES		
1. Aronoff, S. 1989. Geographic Information Systems: A Management Perspective. Ottawa, Canada:WDL Publications. 2. Brovelli, MA and D. Magni. An Archaeological Web Gis Application Based On Mapserver And 3. Burrough, PA Dan McDonnell, RA 1998. Principles of Geographical Information Systems. New York: Oxford University Press 4. Fleming, C., (ed.), 2005. The GIS Guide for Local Government Officials. ESRI Press. Redlands. 5. 5. Muljo Sukojo, B., 2017. Introduction to Geospatial Information, Department of Geomatics Engineering FTSLK ITS Surabaya		

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Course	**Course Name**	**Introduction to Earth Science**
	Course Code	**CF234103**
	Credit (SKS)	**2 (Two)**
	Semester	**1 (One)**

COURSE DESCRIPTION

This course is an introduction to the understanding and utilization of geophysical techniques as an integrated exploration method of the subsurface conditions of the earth. By utilizing a logical methodology (physics, mathematics, geology), by utilizing computational techniques, information techniques and instrumentation. Furthermore, the description of the subsurface conditions is utilized according to the purpose of exploration.

PROGRAM LEARNING OUTCOMES (PLO)	
PLO-4	Able to explain the principles of mathematics, natural science, geology, information technology and engineering principles into geophysical engineering procedures, processes, systems or methodologies
COURSE LEARNING OUTCOMES (CLO)	
CLO-1	[C4,P3,A3] Students are able to recognize the physical characteristics of geological phenomena on the earth's surface through a simple geophysical methodology to obtain an overview of subsurface models and the dynamics of the earth's crust. By building and utilizing a simple model, students can understand its benefits in accordance with the purpose of exploration.
SUB COURSE LEARNING OUTCOMES (SUB CLO)	
Sub CLO-1	[C3,P3,A3] Be able to explain overview of general geophysics in the earth sciences,the theory of the formation of the planet earth, the shape and size of the earth,
Sub CLO-2	[C3,P3,A3] Be able to explain Earth's interior and seismology, earthquakes, gravity, Earth's magnetism, heat flow in the Earth.
Sub CLO-3	[C3,P3,A3] Able to explain the basic concepts of geophysical exploration methods for earth case studies
Sub CLO-4	[C3, P3, A3] Able to review case studies of the implementation of geophysical exploration methods and their development.

STUDY MATERIALS

Introduction to earth models by using data on the earth's surface to explain the dynamics of the earth, from the earth's surface to below the earth's surface.
Using the physical characteristics of the earth (both rocks and soil) to recognize natural phenomena and group them. In this way, students know the boundaries of tectonic plates and their dynamics.
Through measuring these characteristics, students can build a simple model of the earth and are able to use it to recognize the benefits of this knowledge for the application and development of earth exploration technology, within the limits of knowledge and skills for the introductory level; for example: seismology, gravity, volcanology, rock physics, electricity in the fields of energy and the environment.
Simple applications of information technology that can be utilized are: google earth, google maps, GPS, compass.

PRECONDITION
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REFERENCES
1. John Milsom,Asger Eriksen, 2011, Field Geophysics - 304 pages, John Wiley & Sons - Science. 2. William Lowrie, 2007, Fundamentals of Geophysics, Cambridge University Press - Science. 3. Alan E. Mussett,M Aftab Khan, 2000,Looking into the Earth: An Introduction to Geological Geophysics,Cambridge University Press -Science

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Course	**Course Name**	**Geophysical Computation**
	Course Code	**CF234104**
	Credit	**3 (Three)**
	Semester	**1 (One)**
COURSE DESCRIPTION		
This course studies the basic knowledge and programming techniques commonly used in survey design, data processing and modeling of data from geophysical measurement methods.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-4	Able to explain the principles of mathematics, natural science, geology, information technology and engineering principles into geophysical engineering procedures, processes, systems or methodologies	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to understand the importance of computing and master the basics of operating computing software.	
CLO-2	Able to master basic programming with computing software and take advantage of the functions in the software and solve basic problems.	
CLO-3	Able to operate artificial programs based on computational software and able to create their own programs to solve problems in the field of geophysics.	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	Able to understand the basics and importance of computing.	
Sub CLO-2	Able to perform the basics of operating computing software.	
Sub CLO-3	Able to create graphics with computing software.	
Sub CLO-4	Able to do basic programming with computing software.	
Sub CLO-5	Able to perform matrix operations.	
Sub CLO-6	Able to use internal functions and create external functions in computing software.	
Sub CLO-7	Able to solve system problems of linear equations in computational software.	
Sub CLO-8	Able to operate Gauss elimination for inversion problems.	
Sub CLO-9	Able to operate the LU decomposition method in computational software.	
Sub CLO-10	Able to apply the iteration method in computing software.	
Sub CLO-11	Able to perform data interpolation in computing software.	
Sub CLO-12	Able to design computational instructions to solve geophysical problems	
STUDY MATERIALS		
Basic introduction to computing, introduction to computational software, graphing, matrix preparation and operation, external and internal functions, solving systems of linear equations with computation, applying gauss applications in computing, LU decomposition, iteration methods, interpolation, application of numerical computations in geophysical case studies .		
PRECONDITION		
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REFERENCES

1. Beyenir, S., A Brief Introduction to Engineering Computation with MATLAB, 2014.
2. Supriyanto, S., Computing for Science and Engineering Using Matlab, 2010
3. Chapra, S., C., Applied Numerical Methods with MATLAB for Engineers and Scientists Third Edition, 2012.
4. Young, T. and Mohlenkamp C., Introduction to Numerical Methods and Matlab Programming for Engineers, 2017.
5. IOP proceedings article.

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE STAGE (S1)	
Course	**Course Name**	**Calculus 2**
	Course Code	**SM234201**
	Credit (SKS)	**3 (Three)**
	Semester	**2 (Two)**
COURSE DESCRIPTION		
Its transcendent, differential and integral functions Integration Engineering, Improper Integral Integral Applications Polar Forms, Parametric functions, their differentials and integrals Sequence and series		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-2	Able to study and utilize science and technology in order to apply it to mathematical knowledge and be able to make appropriate decisions from the results of their own work or group work in the form of final project reports or other forms of learning activities whose outcomes are equivalent to final assignments through logical, critical thinking, systematic and innovative.	
COURSE LEARNING OUTCOMES (CLO)		
CLO_1	Students are able to apply basic mathematical concepts related to transcendent functions.	
CLO_2	Students are able to apply integration techniques.	
CLO_3	Students are able to apply integration techniques well in the forms of cartesian coordinate functions, polar coordinates and parametric equations.	
CLO_4	Students are able to determine the convergence of infinite sequences and series.	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	Students are able to apply basic mathematical concepts related to transcendent functions.	
Sub CLO-2	Students are able to apply tintegration technique.	
Sub CLO-3	Students are able to apply integration techniques well in the forms of cartesian coordinate functions, polar coordinates and parametric equations.	
Sub CLO-4	Students are able to determine the convergence of infinite sequences and series.	
STUDY MATERIALS		
In this course students will study the following subject matter: 1. Transcendent, differential and integral functions. 2. Integration techniquesand improper integrals. 3. Aapply certain integrals to the area of a plane, the volume of an object, the length of the arc and the area of the shell of a rotating object, the center of mass, application of Guldin's theorem. 4. Polar coordinate systems and parametric equations, their graphical sketches, and their applications. 5. Convergence of sequences and infinite series, and calculating the number of convergent infinite series, Taylor series and seriesMaclaurin.		

PRECONDITION
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REFERENCES
1. ITS Mathematics Department Lecturer Team, Mathematics Textbook 2, 2nd Edition (Revised 2022) ITS Mathematics Department, 2022 2. Anton, H. et al, Calculus, 10-th edition, John Wiley & Sons, New York, 2012 3. Kreyzig, E, Advanced Engineering Mathematics, 10-th edition, John Wiley & Sons, Singapore, 2011 4. Purcell, J, E, Rigdon, S., E., Calculus, 9-th edition, Prentice-Hall, New Jersey, 2006 5. James Stewart ,*Calculus*, ed.7, Brooks/Cole-Cengage Learning, Canada, 2012

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Course	**Course Name**	**Physics of Electricity and Magnetic**
	Course Code	**SF234202**
	Credit (SKS)	**4 (Four)**
	Semester	**2 (Two)**
COURSE DESCRIPTION		
In this course students will learn to understand the basic laws of physics, Electric Field, Electric Potential, Electric Current, Magnetic Field, Induction Electromotive Force (EMF), Alternating Current, through simple mathematical explanations and introducing examples of the use of concepts,and analyze the material in the form of practicum. Five of the following practicums were carried out: (1) Heat Generated by Electric Current, (2) Voltameter. (3) Ohm's Law, (4) Kirchhoff's Law, (5) Alternating Current, (6) Plate Capacitor, (7) Electromagnetic Induction, (8) Thermocouple		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-2	Able to study and utilize science and technology in order to apply it to physics knowledge, as well as being able to make appropriate decisions from the results of one's own work or group work in the form of final assignment reports or other forms of learning activities whose output is equivalent to the final assignment through logical, critical thinking, systematic and innovative.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to formulate, solve and analyze problems with the concepts of Coulomb force, electric field and electric potential.	
CLO-2	Able to formulate, solve and analyze problems in direct current circuits.	
CLO-3	Understand and be able to solve magnetic field problems, induced electromotive force (EMF).	
CLO-4	Able to formulate, solve and analyze problems in alternating current circuits	
CLO-5	Able to apply the concepts of electrical and magnetic physics material through practical activities in the laboratory, analyzing data, and presenting experimental results in the form of practical reports.	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	Able to formulate, solve and analyze problems with the concepts of Coulomb force, electric field and electric potential.	
Sub CLO-2	Able to formulate, solve and analyze problems in direct current circuits.	
Sub CLO-3	Understand and be able to solve magnetic field problems, induced electromotive force (EMF).	
Sub CLO-4	Able to formulate, solve and analyze problems in alternating current circuits	
Sub CLO-5	Able to apply the concepts of electrical and magnetic physics material through practical activities in the laboratory, analyzing data, and presenting experimental results in the form of practical reports.	
STUDY MATERIALS		
Forces and Electric Fields: Electric charge, Coulomb's Law; Electric Field: electric field strength, electric lines of force, calculation of electric field strength for point charges, line charges, rings, disks, cylinders;		

Gauss's law: flux, Gauss's law and its application to calculate electric fields by charged conducting spheres and insulators, charged conducting cylinders and insulators.

Electric Potential:

Potential energy, electric potential difference, relationship between electric potential and electric field, calculation of electric potential for point charges, line charges, rings, disks, cylinders and balls; Capacitors: capacitance, capacitance calculations for parallel plate capacitors, cylindrical capacitors and ball capacitors, series and parallel capacitor circuits, dielectric materials, energy stored in capacitors.

Electric current:

Current and motion of charge, Ohm's law, resistivity, resistance, electric power; Direct current circuit: resistor circuit in series and parallel, Kirchhoff's law.

Magnetic field:

Magnetic flux and induction, Lorentz force, Biot Savard-Ampere's law, magnetic field calculations for straight wires carrying current, rings, solenoids and toroids.

Induction Electromotive Force (EMF).:

Faraday's law, Lenz's law, induced emf, self-inductance and mutual inductance, energy in inductors.

Alternating Current:

Alternating current in resistors, inductors, capacitors, Impedance, RL, RC and RLC circuits in series and parallel, power in alternating current circuits, resonance symptoms.

PRECONDITION

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REFERENCES

1. Sears & Zemanky,"University Physics", Pearson Education, 14th ed, USA, 2016.
2. Douglas C. Giancoli,"Physics for Scientists and Engineers", Pearson Education, 4th ed, London, 2014.
3. Lecturer Team, "Physics II", Physics FMIPA-ITS.
4. Lecturer Team, "Basic Physics Practicum Module/Instructions 2", Physics FMIPA-ITS.
5. Halliday, Resnic, Jearl Walker,"Fundamentals of Physics", John Wiley and Sons, 10th ed., New York, 2014.
6. Tipler, PA, "Physics for Scientists and Engineers", 6th ed, WH Freeman and Co, New York, 2008.

COURSE IDENTITY	***Course Name***	: ***Chemistry***
	Course Code	: **SK23410 2**
	Credits	: ***3 Credits (3/0/0)***
	Semester	: **I/II**
	Teaching Schedule	: ***16 weeks (32 face-to-face meetings)***
COURSE DESCRIPTION	*This course studies the basic principles of chemistry including atomic theory, electron configuration, chemical bonds, state of matter and phase changes, chemical reactions and stoichiometric, Acid-Base Theory, Ionic Equilibrium in Solutions (Acid-Base, Solubility, Complexes, and Precipitation), Chemical Thermodynamics, Chemical Kinetics, and Electrochemistry.*	
LEARNING OUTCOME CHARGED TOTHE COURSE	ITS: 1. *Able to study and utilize science and technology in order to apply it to chemical knowledge and be able to make appropriate decisions from the results of their own workor group work in the form of final project reports or other forms of learning activities whose outcomes are equivalent to final assignments through logical, critical thinking, systematic and innovative* (PLO 2) *Department:* 1.	
COURSE LEARNING OUTCAME	1. *The students should be able to use the principles of basic chemistry knowledge as a basisto learn chemistry inwhich they will learn further throughout their whole studies* 2. *The students should be able to do the basic chemistry calculations* 3. *The students should be able to make appropriate decisions to solve the problems inchemistry or related fields, based on the results of information and data analysis* 4. *The students should be able to apply a logical mindset to solve problems in daily life*	
SUBJECT	***1. Atomic Structure*** • *Introduction to matter (elements, compounds, physical properties, chemicalproperties)* • *The basic laws of combining elements (Proust, Lavoisier, Dalton)* • *Development of atomic models and structures* • *The underlying experiments (Dalton, Thompson, Rutherford, Bohr and the HydrogenAtomic Spectrum)* • *The electron configuration of an element and an ion* • *Periodic System of Elements* • *The periodicity of the elements* ***2. Stoichiometry*** • *Calculation of the concept of mole* • *Empirical formula and molecular formula* • *Concentration Units (M, N, %, m, F, ppm, ppb)* • *Stoichiometry in Solution* • *Standardization*	

3. ***Chemical Bond***
   - *Polar covalent and covalent bonds, dipole moments, metallic bonds, hydrogen bonds,and Van der Walls bonds*
   - *Molecular geometry and structure (Lewis structure, and hybridization)*

4. ***State of Matter***
   - *Forms of Gases (Laws of gases and their physical properties)*
   - *Liquid State (physical properties of liquids: vapor pressure, boiling point, surfacetension, viscosity)*
   - *Colligative Properties of Solutions*
   - *Solids (Crystal lattice, simple simple cube, face centered cubic , body centered cubic ,Miller index, Bragg equation)*

5. ***Solution***
   - *Acid-Base Theory (Arrhenius Theory, Brønsted-Lowry, Lewis Theory)*
   - *Degree of ionization and ionization constant*
   - *Acid Base Strength*
   - *Weak acid-base balance*
   - *Ionic equilibrium between solid and solution*
   - *Buffer System*
   - *Solubility*

6. ***Thermodynamics***
   - *Thermodynamics concepts (principles, states and processes)*
   - *First Law of Thermodynamics: internal energy, work and heat*
   - *Heat capacity, calorimetry and enthalpy*
   - *Second Law of Thermodynamics and spontaneity*
   - *Thermochemistry and its use to explain the spontaneity of chemical reactions*
   - *Calculations related to the Carnot engine application*

7. ***Chemical equilibrium***
   - *Concept of Chemical Equilibrium and Equilibrium Constant (Reaction quotient,equilibrium constant Kp and Kc)*
   - *Le Chatelier's Principle*
   - *Factors affecting chemical equilibrium*

8. ***Chemical Kinetics***
   - *Chemical kinetics concept*
   - *Rate in chemical reaction*
   - *Determination of reaction rate, order and rate constant of reaction*
   - *Effect of temperature on reaction rate*
   - *Elementary reaction*
   - *Catalyst*

9. ***Electrochemistry***
   - *Redox reaction concept*
   - *Electrochemical cell (electrode and electrolyte solution in electrochemical cell)*
   - *Effect of concentration and Nerst . equation*
   - *Use of electrochemical concepts for voltaic cell applications (battery and fuel cells)and electrolysis*
   - *Corrosion and corrosion prevention*

	10. Enrichment *Topics according to the faculty's area of interest (per faculty)*
Pre-Requisite Courses	- -
REFERENCE	1. *Chemistry 1 (compiled by the Lecturer Team of the Department of Chemistry)* 2. *Oxtoby, DW, Gillis, HP and Campion, A. , "Principles of Modern Chemistry", 7thEdition, Brooks/Cole, 2012.* 3. *Chang, R. and Goldsby, K., "Chemistry", 11th Edition, McGraw-Hill, USA, 2012.* 4. *Goldberg, DE, "Fundamentals of Chemistry", 4th Edition, McGraw-Hill Companies,2007.*

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
Course	**Course Name**	**Petrology**
	Course Code	**CF234205**
	Credit (SKS)	**3 (Three)**
	Semester	**2 (Two)**

COURSE DESCRIPTION

This course explains the classification and description of igneous, sedimentary and metamorphic rocks based on texture, structure and mineralogical and chemical composition aspects. In addition, it also discusses the origins and processes of rock occurrence in the dimensions of space and time, in relation to the theory of plate tectonics and rock associations in various geological conditions. This course applies the case learning method.

PROGRAM LEARNING OUTCOMES (PLO)	
PLO-4	Able to explain the principles of mathematics, natural sciences, geology, geospatial, instrumentation, information technology, engineering principles and designs into geophysical engineering procedures, processes, systems or methodologies.
COURSE LEARNING OUTCOMES (CLO)	
CLO-1	Able to explain the concept of formation and classification of igneous rocks
CLO-2	Able to explain the concept of formation and classification of sedimentary rocks
CLO-3	Able to explain the concept of formation and classification of metamorphic rocks
SUB COURSE LEARNING OUTCOMES (SUB CLO)	
Sub CLO-1	[C2,A3] Able to explain the concept of igneous rock formation
Sub CLO-2	[C2,A3] Able to explain the concept of igneous rock classification
Sub CLO-3	[C2,A3] Able to explain the concept of sedimentary rock formation
Sub CLO-4	[C2,A3] Able to explain the concept of sedimentary rock classification
Sub CLO-5	[C2,A3] Able to explain the concept of metamorphic rock formation
Sub CLO-6	[C2,A3] Able to explain the concept of metamorphic rock classification

STUDY MATERIALS

- Rock cycle
- Rock forming minerals
- Magma formation
- Igneous rock genesis
- Classification of igneous rocks
- Volcanism processes and their products
- Sedimentary rock genesis
- Classification of sedimentary rocks
- Texture and structure of sedimentary rocks
- Metamorphic rock genesis
- Classification of metamorphic rocks
- Metamorphism facies
- Petrography of rock forming minerals

PRECONDITION

Physical Geology

REFERENCES

1. Boggs, S., Jr., 2009, Petrology of Sedimentary Rocks, 2nd Edition, Cambridge University Press,Cambridge, 600h.
2. Frost, B.R., Frost, C.D., 2014, Essentials of Igneous and Metamorphic Petrology, CambridgeUniversity Press, Cambridge, 303h.
3. Tucker, M.E., 2001, Sedimentary Petrology: An Introduction to the Origin of Sedimentary Rocks,3rd Edition, Blackwell Scientific Publications, Oxford, 262h.
4. Winter, J.D., 2014, Principles of Igneous and Metamorphic Petrology, 2nd Edition, Pearson, Edinburgh, 737h.
5. Publications on petrology

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
Course	**Course Name**	**Fundamentals of Electronics**
	Course Code	**CF234206**
	Credit (SKS)	**3 (Three)**
	Semester	**2 (Two)**
COURSE DESCRIPTION		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-4	Able to explain the principles of mathematics, natural science, geology, information technology and engineering principles into geophysical engineering procedures, processes, systems or methodologies	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to identify and apply electronic components	
CLO-2	Able to carry out electronic circuit analysis	
CLO-3	Able to understand the concept of electronic measurements	
CLO-4	Able to understand the application of semiconductor materials	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	Able to identify and apply electronic components	
Sub CLO-2	Able to carry out electronic circuit analysis	
Sub CLO-3	Able to understand the concept of electronic measurements	
Sub CLO-4	Able to understand the application of semiconductor materials	
STUDY MATERIALS		
1. Material Review Basic concepts of DC circuits: system of units, charge and current, voltage, power and energy, 2. Electronic components and electronic measurement concepts (R, C, L, voltage) 3. Basic laws: ohm's law (point, branch and loop), kirchoff's law, series-parallel resistors, voltage divider and current divider, wye-delta transformation 4. DC circuit analysis methods: point analysis, point analysis with voltage source, mesh analysis, mesh analysis with current source 5. Circuit theorems: linearity, superposition, Thevenin's Theorem, Norton's Theorem and maximum power transfer 6. Sinusoids, Phasors, phasor relationships for circuit elements, impedance, Instantaneous power and average power, maximum power transfer, effective and rms value, power factor 7. Analog electrical metering I,V,R 8. First order circuits: series and parallel, source-independent RC circuits, source-independent RL circuits, singularity function, step response for RC and RL circuits, 9. Transient state, RLC circuit, low pass filter, high pass filter, transfer function, amplitude response, phase response, Bode plot approach 10. Introduction to the Laplace transform and its application to solving electrical circuits 11. Diode:Semiconductor materials, p type semiconductors, n type semiconductors, pn junctions, diodes, diode characteristics, types and types of diodes 12. Use of diodes as rectifiers, Zener diodes, unregulated dc power supplies, diode application circuits 13. Transistor:Bipolar transistors: pnp and npn transistors, transistor characteristics, transistor equivalent circuits, grounded base amplifier (CB), grounded emitter (CE)	

amplifier, grounded collector (CC) amplifier, voltage amplifier, transistor as a small current amplifier, ac and dc load lines .

14. Applicationtransistors as amplifiers and switches
15. Introduction to Op Amp: characteristics, Inverting, Non inverting, summing and comparator.

PRECONDITION

Basic Physics

REFERENCES

1. Charles K. Alexander, Matthew NO Sadiku, Fundamentals of Electric Circuits, Fifth Edition, 2012.
2. JW Nilssson and S. A, Riedel, 2008, Electronic Circuits, PearsonPrentice Hall.
3. Boylestad, 2002, Introductory Circuit Analysis, 10th edition, Prentice Hall.
4. Instrumentation Lecturers, Basic Electronics Practicum Module 1
5. Millman and Halkias, 2001, Integrated Electronics, Tata McGraw-Hill.
6. Robert L Boylestad and Louis Nashelsky, 2009, Electronic Devices and Theory, 10 edition, Pearson Education.

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
Course	**Course Name**	**Geophysical Data Modeling**
	Course Code	**CF234207**
	Credit (SKS)	**3 (Three)**
	Semester	**2 (Two)**
COURSE DESCRIPTION		
This course covers the basic concepts of inversion, determining inversion parameters and solving inversion problems using several methods in geophysics. The course applies cased method-project based learning		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Students are able to understand the concepts of mathematics, natural science, information technology and engineering principles into geophysical engineering procedures, processes, systems or methodologies to create or modify models using the Inversion Method	
CLO-2	Students are able to identifysource of problems, formulating alternative solutions, analyzing appropriate information and computing technology-based analysis in solving geophysical problems using the Inversion Method	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C3,P3,A3] Able to master the concepts and principles of mathematics and natural science in inversion methods including linear and non-linear inversion in Geophysical methods	
Sub CLO-2	[C3,P3,A3] Able to identify, formulate, analyze and solve inversion problems using Geophysical-Gravity and Magnetic methods	
Sub CLO-3	[C3,P3,A3] Able to identify, formulate, analyze and solve inversion problems using Geophysical-Seismic methods	
Sub CLO-4	[C3,P3,A3] Able to identify, formulate, analyze and solve inversion problems using Geophysical-Geoelectrical methods	
STUDY MATERIALS		
Determination of model parameters, Formulation of linear inverse problems, Linear models, Linearization of parameters, Uncertainty and characteristics of inverse problem solutions, Curve fitting, General inversion matrix, Correlation matrix, Single Value Decomposition (SVD), Damped Least Square; Non-Linear Inversion		
PRECONDITION		
Calculus II and Computational Geophysics		

REFERENCES

1. Menke, W, "Geophysical Data Analysis, Discrete Inverse Theorem", Academic Press, 2018.
2. Aster, et al," Parameter Estimation and Inverse Problems", Elsevier, 2018
3. Tarantola, Albert, Inverse problem theory and methods for model parameter estimation, 2005, the Society for Industrial and Applied Mathematics.

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
Course	**Course Name**	**Geodynamics**
	Course Code	**CF234308**
	Credit (SKS)	**2 (Two)**
	Semester	**3 (Three)**

COURSE DESCRIPTION

This course explains, among other things: the basics of depositional basin formation related to the environment and the movement of tectonic plates, the rheology of the earth's crust and rocks and changes in their character to various forces affecting them, the mechanism of basin formation due to stretching, flexuring, and its association with strike-slip deformation in the lithosphere, the classification and dynamics of basin filling and the stratigraphic sequence that may have formed. Interpretation and discussion of ectonostratigraphic evolution is based on surface and subsurface data for selected areas representing forearc, volcanic arc and backarc basins; potential geological resources as an implementation of understanding tectonostratigraphic evolution. The course applies the case learning method.

PROGRAM LEARNING OUTCOMES (PLO)	
PLO-4	Able to explain the principles of mathematics, natural science, geology, geospatial, instrumentation, information technology, engineering principles and design into geophysical engineering procedures, processes, systems or methodologies.
COURSE LEARNING OUTCOMES (CLO)	
CLO-1	Able to explain the concept of the development of tectonic theory and basin formation
CLO-2	Able to apply and analyze Indonesian geodynamics
SUB COURSE LEARNING OUTCOMES (SUB CLO)	
Sub CLO-1	[C2,A3] Be able to explain the concept of the development of tectonic theory
Sub CLO-2	[C2,A3] Able to explain the concept of basin studies
Sub CLO-3	[C3,A3] Able to apply the concepts of tectonic theory and basin studies to Indonesian geodynamics
Sub CLO-4	[C3,A3] Able to apply geodynamic concepts to the analysis of the existence of resources and geological disasters

STUDY MATERIALS

- Development of tectonic theory: Geosynclines and Undations
- Development of tectonic theory: Plate tectonics, terrane tectonics and mantle plume
- Basin formation
- Basin filling
- Basin evolution
- Geodynamics of Java Island
- Geodynamics of Sumatra
- Gedynamics of Kalimantan
- Geodynamics of Sunda Land
- Geodynamics of Sulawesi
- Geodynamics of Nusa Tenggara
- Geodynamics of Papua
- Eastern Indonesia Geodynamics
- The relationship of geodynamics to geological resources and disasters

PRECONDITION
Structural Geology
REFERENCES
1. Allen, P.A, and J.R. Allen (2005) Basin Analysis: Principles and Applications, 2nd ed. Blacwell Publishing, Malden, 549 hal. 2. Einsele, G. (2000) Sedimentary Basins: Evolution, Facies, and Sediment Budget, 2nd ed. Springer Verlag, Berlin, 792 hal. 3. Mike R. Leeder, M.R. (2011) Sedimentology and Sedimentary Basins: From Turbulence to Tectonics, 2nd ed., Wiley-Blackwell, 784 p. 4. Darman, H. and S.F. Hasan. (eds.) (2000) An outline of the geology of Indonesia. Ikatan Ahli Geologi Indonesia. 192 p. 5. Barber, A. J., M. J. Crow, and J. S. Milsom, eds. (2005) Sumatra: geology, resources and tectonic evolution. Geological Society London Memoir 31., 300 p. 6. Hall, R., and D. J. Blundell, eds. (1996) Tectonic evolution of SE Asia. Geological Society of London Special Publication 106., 566 p.

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
Course	**Course Name**	**Structural Geology**
	Course Code	**CF234309**
	Credit (SKS)	**3 (Three)**
	Semester	**3 (Three)**
COURSE DESCRIPTION		
This course explains rock deformation, deformed structures in rocks (igneous rock, sedimentary rock, and metamorphic rock which includes joints, faults, foliation folds, rock cleavage, etc.), the origin of the style of structure formation (plate tectonic theory), presentation structures on geological maps and cross-sections, contour structures, unconformities. A field trip was held to introduce geological structures in the field, how to measure and analyze them. The course applies the case learning method.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-4	Able to explain the principles of mathematics, natural science, geology, geospatial, instrumentation, information technology, engineering principles and design into geophysical engineering procedures, processes, systems or methodologies.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to explain the concept of geological structure formation and its depiction on stereographic projections	
CLO-2	Able to apply and analyze the depiction of geological structures on geological maps	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C2,A3] Able to explain the concept of deformation and rock rheology	
Sub CLO-2	[C2,A3] Able to explain the concept of geological structure lines and their depiction on a stereographic plane	
Sub CLO-3	[C2,A3] Able to apply depiction of geological structures on topographic maps and geological maps	
Sub CLO-4	[C2,A3] Able to apply geological structures to subsurface data	
STUDY MATERIALS		
• Deformation process • Stress vs strain and brittle vs ductile • Line structure and strike dip • Sterographic projection • Sturdy structure • Fault structure • focal mechanism • Active fault • Structure of folds and unconformities • V topographical and legal maps • Depiction of geological structures on a map • Simple geological profile • Structural geomorphology • Identification of subsurface geological structures		
PRECONDITION		
Petrology and Mapping		

REFERENCES

1. Groshong, R. H. Jr., 2008, 3-D Structural Geology, 2nd Edition. Springer-Verlag, Heidelberg, 400p
2. Lisle, R.J. dan Leyshon, P.R., 2004, Stereographic Projection Techniques, 2nd Edition, Cambridge University Press, 112 p.
3. Price, N.J. & Cosgrove J.W., 1990, Analysis of Geological Structures, Cambridge University Press, New York.
4. Ragan, D.M., 2009, Structural Geology, An Introduction to Geometrical Technique, 4th Edition, Cambridge University Press, 602 p.
5. Ramsay, J.G., & Huber, M.I., 1987, The Techniques of Modern Structural Geology, volume 1 dan 2, Elsevier Academic Press.
6. Tomecek, S.M., 2009, Plate Tectonics, Chelsea House Publishers, New York, 102 p.
7. Journals and publications

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
Course	**Course Name**	**Rock Physics**
	Course Code	**CF234310**
	Credit	**4 (Four)**
	Semester	**3 (Three)**
COURSE DESCRIPTION		
This course explains the characteristics of rocks as porous media that are elastic, at the micro scale. The characterization is carried out based on measurements of physical variables and the relationships between existing variables to obtain important physical parameters that can be used later in geophysical exploration, especially on a macro scale, starting from evaluating well logs to geophysical measurements in the field. Evaluation of the physical characteristics of the rock is able to provide corrections and guidance in evaluating subsurface physical conditions in accordance with exploration objectives. The course material covers knowledge of the physical properties (elasticity, electricity, hydrodynamics) of the rock matrix, the presence of pores in rocks, the presence of fluids (both single and multi-phase) in the pores.		
PROGRAM LEARNING OUTCOMES (PLO)		
CLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
CLO-6	Able to apply processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data procedurally starting from identifying, formulating, analyzing and finding the source of the problem, proposing the best solution to solve the problem, designing and operationalizing the process, processing systems and hardware and software equipment required in existing geophysical engineering designs, local and national resources as well as engineering design and analysis tools that are most appropriate, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account factors law, economics, environment, socio-cultural, political, health, public safety, culture,and sustainable development.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to master the basic principles of rock physics parameters in the application of the earth field	
CLO-2	Able to master the concepts and techniques for designing rock physical parameter measurement tools	

SUB COURSE LEARNING OUTCOMES (SUB CLO)	
Sub CLO-1	[C4,P3,A3] Able to understand the concepts and relationships between rock physical variables to extract important rock parameters for exploration purposes.
Sub CLO-2	[C4,P3,A3] Able to implement physical parameter measurements in the laboratory with a variety of rock samples.
Sub CLO-3	[C4,P3,A3] Able to explain the development of science and technology of physical parameter measurement methodology.
Sub CLO-4	[C4,P3,A3] Able to design a simple measurement system (tools and methodology) to be followed up by measuring rock physics variables on a laboratory scale.

STUDY MATERIALS

Introduction: background and basic understanding of rock physics, rocks as part of the earth's crust and soil as a result of chemical-physical weathering of rocks, rocks and soil as part of the earth's crust.

Measurement and modeling of rock physics characteristics: design of rock physics data acquisition and measurement on a laboratory scale and its development on a field scale.

Rock characteristic variables and parameters: solid material (matrix), pore space and fluid content in the pores which influence each other.

Application: relationship of rock characteristics at various rock physics measurement scales and its application in geophysical exploration in the field.

PRECONDITION

Basic Physics II, Calculus II

REFERENCES

1. Schoon, J.H., 1998, Physical Properties of Rocks: Fundamental and Principles Of Petrophysics, Pergamon.
2. Bowless J E, 1979, Physical and Geotechnical Properties of Soils, Mc Graw hill Co, Toky
3. Mavko, Gary., et al, 2009, The Rock Physics Handbook, Cambridge University Press, UK.
4. Terzghy K, dkk, 1997, Soil Mechanics in Enginering Practise, Prantice Hall, NY
5. Journals and Proceedings

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
Course	**Course Name**	**Mathematical Geophysics**
	Course Code	**CF234311**
	Credit	**3 (Three)**
	Semester	**3 (Three)**
COURSE DESCRIPTION		
This course covers basic mathematical concepts in geophysics, Fourier analysis (Fourier series, Fourier Transform, Fast Fourier Transform, Discrete Fourier Transform), complex numbers, application of special functions in solving Geophysical cases (signal processing), Gamma Function, Beta Function, Laplace, Legendre and Bessel		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-4	Able to explain the principles of mathematics, natural science, geology, geospatial, instrumentation, information technology, engineering principles and design into geophysical engineering procedures, processes, systems or methodologies.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	[C3, P3, A3] Able to apply the basic concepts of Geophysical Mathematics and apply them in the field/problems of Geophysics. Able to solve Fourier Analysis problems, Complex & Euler Numbers, Special Functions, Solutions to Series of Differential Equations, Functions; Legendre, Bessel, Hermite and other special functions.	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	Able to understand and apply Fourier Analysis	
Sub CLO-2	Able to solve complex algebraic problems and calculations with Euler's Formula	
Sub CLO-3	Able to solve Gamma function equations, Betha and Legendre equations	
Sub CLO-4	Able to explain the importance of mathematics in solving geophysical problems using written tests	
Sub CLO-5	Able to understand the properties and use the Bessel Equation	
Sub CLO-6	Able to understand the properties and use the Hermite Function	
Sub CLO-7	Able to understand the properties and use the Laguerre Function	
Sub CLO-8	Able to apply applications in geophysical exploration problems	
STUDY MATERIALS		
• Introduction, basic mathematical concepts in geophysics • Fourier Series (FS), Fourier Transform (FT) • Fast Fourier Transform (FFT), Discrete Fourier Transform (DFT) • Complex numbers, complex fields, complex algebra, Euler's formula, complex power series, powers and roots of complex numbers • Definition of Gamma Function, Recursion Relation Function, Applications of Gamma Function • Gamma Functions – Beta Functions, Error Functions, Integrals, Stirling Formulas, Elliptic • Legendre equation, Leibinz rule, Rodrigues Formula • Generating Functions of Legendre Polynomials, Orthogonal Functions; association, Normalization and Legendre series		

- Bessel equation; equation solutions, Recursion Relations, Differential Equation Solutions, other Bessel Functions
- Multiple integral, double integral, triple integral
- Case Base Study & Case Base Project in the exploration of the Geophysics Method

PRECONDITION

Calculus 1, Calculus 2, Physics of Mechanics, Physics of Electricity and Magnetism

REFERENCES

1. Hubral, P., Mathematical Methods for Geophysics, University of Karlsruhe Press, 2001.
2. Michael S. Zhdanov, Geophysical Inverse Theory and Regularization Problems, Elsevier, 2002.
3. Boas, ML, Mathematical Method in Physical Sciences, Jhon Wiley and Sons 3rd edition, 2006.
4. Kreyzig, Erwin, advance Engineering Mathematics, Jhon Wiley and Sons 9th edition, 2006
5. Geophysical journal

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
Course	**Course Name**	**Seismology**
	Course Code	**CF234312**
	Credit	**3 (Three)**
	Semester	**3 (Three)**
COURSE DESCRIPTION		
This course studies aboutphenomena related to earthquake vibrations and able to explain the concept of earthquake wave propagation		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-4	Able to explain the principles of mathematics, natural science, geology, information technology and engineering principles into geophysical engineering procedures, processes, systems or methodologies	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Students understand phenomena related to earthquake vibrations and are able to explain the concept of earthquake wave propagation	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	Able to understandA brief history of seismology	
Sub CLO-2	Able to understandstress and strain	
Sub CLO-3	Able to understandseismic wave equation	
Sub CLO-4	Able to understandRay theory: travel time	
Sub CLO-5	Able to understandinversion of travel time data	
Sub CLO-6	Able to understandray theory: amplitude and phase	
Sub CLO-7	Able to understandreflection seismology	
Sub CLO-8	Capable of understandingsurface waves	
Sub CLO-9	Able to understandearthquakes and source theory	
Sub CLO-10	Able to understandearthquake prediction	
Sub CLO-11	Able to understandinstruments, noise and anisotropy	
Sub CLO-12	Able to understand the application of seismology	
STUDY MATERIALS		
A brief history of seismology, stress and strain, seismic wave equations, ray theory: travel time, inversion of travel time data, ray theory: amplitude and phase, reflection seismology, surface waves, earthquake and source theory, earthquake prediction, instruments, noise and anisotropy.		
PRECONDITION		
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REFERENCES		

1. Shearer, P. M., 2009, Introduction to Seismology, Cambridge University Press, Cambridge, UK
2. Zobin, V. M., 2012, Introduction to Volcanic Seismology, Elsevier, London, UK.
3. Jens Havskov, Gerardo Alguacil (auth.)-Instrumentation in Earthquake Seismology-Springer International Publishing (2016)
4. Barbara Romanowicz, Adam Dziewonski-Seismology and Structure of the Earth_ Treatise on Geophysics-Elsevier (2009)
5. Agustin Udías-Principles of Seismology-Cambridge University Press (2000).

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
Course	**Course Name**	**Seismic Exploration**
	Course Code	**CF234313**
	Credit (SKS)	**3 (Three)**
	Semester	**3 (Three)**
COURSE DESCRIPTION		
This course explains the basic concepts of seismic wave propagation phenomena as well as the use of Active Seismic Methods (Reflection - Refraction) and Passive Seismic Methods. The course applies case method-project based learning.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data procedurally starting from identifying, formulating, analyzing and finding the source of the problem, proposing the best solution to solve the problem, designing and operationalizing the process, processing systems and hardware and software equipment required in existing geophysical engineering designs, local and national resources as well as engineering design and analysis tools that are most appropriate, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account factors law, economics, environment, socio-cultural, political, health, public safety, culture,and sustainable development.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to explain the concept of Seismic Methods (Basic Sciences, physical parameters and basic laws).	
CLO-2	Able to implement the Seismic Method procedurally starting from data search, processing, subsurface geology and modeling to solve deep problems.	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C2, A3] Able to explain the basic concepts and principles of seismic waves and their relationship to the physical characteristics of rocks using written tests.	
Sub CLO-2	[C3, P3, A4] Able to implement the Seismic Refraction Exploration method procedurally.	
Sub CLO-3	[C3,P3,A4] Able to implement the Reflection Seismic Exploration method procedurally.	

Sub CLO-4	[C3,P3,A4] Able to implement the Passive Seismic Exploration method procedurally.

STUDY MATERIALS

- Elastic properties of earth materials
- Seismic wave propagation theory
- Ray theory
- Seismic wave speed & Seismic event characteristics
- Seismic Refraction-Seismic Reflection (Basic Concepts): Reflection, refraction and CDP surveys; land and marine seismic sources, generation and propagation of elastic waves, velocity – depth models, geophones, hydrophones, recording instruments (DFS), digital formats, field layouts, seismic noises and noise profile analysis, optimum geophone grouping, noise cancellation by shot and geophone arrays
- Acquisition and processing of Refraction-Reflection Seismic data
- Simple interpretation and modeling of Seismic Refraction-Seismic Reflection
- Introduction to Passive Seismic Methods
- Utilization of seismic methods in geophysical exploration

PRECONDITION

Seismology
Geophysical Data Modeling
Structural Geology

REFERENCES

1. Shearer, P. M., 2009, Introduction to Seismology, Cambridge University Press, Cambridge, UK.
2. Zobin, V. M., 2012, Introduction to Volcanic Seismology, Elsevier, London, UK.
3. Jens Havskov, Gerardo Alguacil (auth.)-Instrumentation in Earthquake Seismology-Springer International Publishing (2016)
4. Barbara Romanowicz, Adam Dziewonski-Seismology and Structure of the Earth_ Treatise on Geophysics-Elsevier (2009)
5. Agustin Udías-Principles of Seismology-Cambridge University Press (2000).
6. Applied Geophysics – Seismic Method
7. Keilis-Borok (auth.), V. I. Keilis-Borok, Edward A. Flinn (eds.)-Computational Seismology-Springer US (1995)
8. Geophysical Journal

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
Course	**Course Name**	**Magnetic and Gravity Exploration**
	Course Code	**CF234314**
	Credit	**3 (Three)**
	Semester	**3 (Three)**
COURSE DESCRIPTION		
This course discusses the theory of the earth's potential field which underlies gravity and magnetic exploration, the application of acquisition design based on exploration targets, data processing which includes reduction and filtering, interpretation of subsurface structures from gravity and magnetic anomaly data and case studies in the field of geoscience		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data procedurally starting from identifying, formulating, analyzing and finding the source of the problem, proposing the best solution to solve the problem, designing and operationalizing the process, processing systems and hardware and software equipment required in existing geophysical engineering designs, local and national resources as well as engineering design and analysis tools that are most appropriate, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account factors law, economics, environment, socio-cultural, political, health, public safety, culture,and sustainable development.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to explain concepts, methods, acquisition, processing and interpretation of gravity and magnetic data	
CLO-2	Able to produce solutions to gravity and magnetic exploration problems	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	Able to explain methods and applications of gravity and magnetic exploration, potential field theory, density and magnetic properties of rocks	
Sub CLO-2	Able to carry out data acquisition, processing, filtering and interpretation	
Sub CLO-3	Able to apply gravity and magnetic exploration concepts to obtain accurate subsurface interpretations	
Sub CLO-4	Able to analyze and draw appropriate conclusions in gravity and magnetic exploration	

STUDY MATERIALS
▪ **Introduction**: Geophysical methods in general, basic concepts of the gravity method ▪ **Gravity method**: the earth's gravitational field, history of the gravity method, application of the gravity method ▪ **Gravitational potential field**: gravity caused by various shapes of objects, synthetic models of gravity sources, ambiguity of gravity anomalies ▪ **Rock density**: rock density and density measurements ▪ **Gravity data acquisition**: gravity measurements and surveys ▪ **Gravity data processing**: gravity anomalies, gravity data filtering techniques ▪ **Gravity anomaly interpretation**: parameter interpretation, simple interpretation, anomaly source modeling ▪ **Magnetic method**: Basic concepts of magnetic methods, Earth's magnetic field, history of magnetic method exploration, application of magnetic methods ▪ **Magnetic potential theory**: magnetic potential and effects of dipole points and bodies, synthetic models of magnetic sources, total magnetic moment, ambiguity of magnetic anomalies ▪ **Magnetization of earth materials**: magnetism of earth materials, mineral magnetism, magnetic susceptibility, magnetization of rocks and soil, mapping of magnetic values ▪ **Magnetic data acquisition**: instrumentation, survey design and procedures, magnetic measurements ▪ **Magnetic data processing:**magnetic field variations, magnetic data filtering techniques ▪ **Interpretation of magnetic anomalies**: interpretation techniques, anomaly source modeling ▪ **Application of gravity and magnetic methods**: near surface exploration, identification of energy sources, exploration of mineral resources and geological studies
PRECONDITION
Geophysical Data Modeling, Mathematical Geophysics, Rock Physics, Geodynamics
REFERENCES
1. Hinze, William J., 2012, Gravity and Magnetic Exploration, Cambridge University Press, UK. 2. Roy, Kalyan Kumar, 2007, Potential Theory in Applied Geophysics, Springer, Berlin. 3. Pasteka, Roman, dkk, 2017, Understanding the Bouguer Anomaly, Elsevier, Netherlands. 4. Related journals

	INTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
Course	**Course Name**	**Capita Selecta-1**
	Course Code	**CF234325**
	Credit	**2 (Two)**
	Semester	**3 (Three)**
COURSE DESCRIPTION		
This course studies the basic science and techniques of programming using the Python programming language and applies machine learning algorithms for use in processing and modeling data from geophysical method measurements. The course applies case method-project based learning.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply procedural processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data starting from identifying, formulating, analyzing and finding the source of problems, proposing the best solutions to solve problems, designing and operationalizing processes, processing systems and hardware and software equipment needed in existing geophysical engineering designs, local, national resources and engineering design and analysis tools that are most suitable, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account factors law, economics, environment, socio-cultural, political, health, public safety, culture,and sustainable development.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to master programming using the Python programming language and create simple programs to process geophysical data.	
CLO-2	Able to understand machine learning algorithms and create geophysical data processing programs using machine learning algorithms	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C4, P3, A3] Able to operate Python software and utilize its functions	
Sub CLO-2	[C4,P3,A3] Able to implement Python programming to solve basic problems in the field of geophysics	
Sub CLO-3	[C4,P3,A3] Able to understand machine learning algorithms and write in the python programming language	
Sub CLO-4	[C4, P3, A3] Able to create geophysical data processing programs using machine learning algorithms	

STUDY MATERIALS
• Python programming basics • Python Libraries • Regression and classification • Clustering • Statistics and Probability • Machine Learning Algorithms • KNN
PRECONDITION
Computational Geophysics
REFERENCES
1. Hetland, Magnus Lie. (2010) Python Algorithms: Mastering Basic Algorithms in the Python Language. 2010 2. Johansson. (2019) Numerical Python: Scientific Computing and Data Science Applications with Numpy, SciPy and Matplotlib. 2019 3. Raschka. (2019) Python Machine Learning. 2019 4. Jurnal Geofisika dan Proceeding AAPG dan IPA

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
Course	**Course Name**	**Principles of Stratigraphy**
	Course Code	**CF234415**
	Credit	**1 (One)**
	Semester	**4 (Four)**

COURSE DESCRIPTION

Students can understand the genesis of sedimentary rocks and their relationship in space and time. These two definitions will provide provisions for students to understand the geometry of sedimentary rock layers which can then be used to interpret the distribution and properties of the rock, and ultimately interpret or calculate the value of the economic content in the sedimentary rock.

PROGRAM LEARNING OUTCOMES (PLO)	
PLO-4	Able to explain the principles of mathematics, natural science, geology, geospatial, instrumentation, information technology, engineering principles and design into geophysical engineering procedures, processes, systems or methodologies.
COURSE LEARNING OUTCOMES (CLO)	
CLO-1	Able to apply the concept of layering and its changes to sedimentary rocks
CLO-2	Able to implement the concept of rock strata in sedimentary rocks with implementation in the field (due to tectonic factors, depositional environment) according to certain geological conditions and time
SUB COURSE LEARNING OUTCOMES (SUB CLO)	
Sub CLO-1	[C2,A3] Able to explain the basics of rocks and their cycles including mineralization originating from magma differentiation
Sub CLO-2	[C3, P3, A4] Able to explain the processes and depositional environment of sediments as well as the relationship between strata of sediments in certain geological conditions.
Sub CLO-3	[C3, P3, A4] Able to process and explain the results of sediment mapping taken from certain geological conditions
Sub CLO-4	[C3, P3, A4] Able to process data from sediment mapping in certain conditions

STUDY MATERIALS

1. Law and Stratigraphy
2. Land Depositional Environment
3. Marine Depositional Environment
4. Sedimentation Facies
5. Lithostratigraphy
6. Biostratigraphy and Chronostratigraphy
7. Seismic Stratigraphy and Sequence Stratigraphy
8. Subsurface data stratigraphy
9. Measured Stratigraphy
10. Stratigraphic Data Analysis
11. Regional Geological Map
12. Regional Geological Profile and Analysis
13. Geological Survey and Mapping
14. Making Geological Maps

PRECONDITION
Structural Geology
REFERENCES
1. Dunbar, CO and Rodgers, J (157), Principal Of Stratigraphy 2. Schoch, R.M., (1989), Stratigraphy: Principals and Methods 3. Boggs, Sam (2001) Principles of Sedimentology and Stratigraphy 4. Boggs, Sam (2001) Petrology of Sedimentary Rock 5. Journal of Sedimentary Research 6. Magnus Wangen, Physical Principles Of Sedimentary Basin Analysis 7. Journal of Sedimentology and Stratigraphy

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
Course	**Course Name**	**Geophysical Digital Data Analysis**
	Course Code	**CF234416**
	Credit	**3 (Three)**
	Semester	**4 (Four)**
COURSE DESCRIPTION		
This course studies the basics of digital signal analysis which are commonly used in geophysical data analysis such as Fourier transform, discrete Fourier transform, convolution, correlation, sampling theory, digital signal phase properties and filtering.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to understand the basic concepts of digital data analysis in Geophysical data processing (Basic Sciences, physical parameters and basic laws).	
CLO-2	Able to implement GEOPHYSICS DIGITAL DATA ANALYSIS in designing geophysical data processing (filters, sampling, image processing) to produce and optimize data processing to produce/provide quality data for interpretation	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C2, A3, P2] Able to explain the basic concepts and principles of GEOPHYSICS DIGITAL DATA ANALYSIS in processing geophysical data.	
Sub CLO-2	[C3, P3, A4] Able to implement the GEOPHYSICS DIGITAL DATA ANALYSIS methodology in geophysical data processing	
Sub CLO-3	[C3, P3, A4] Able to implement and analyze the results of geophysical data processing	
Sub CLO-4	[C3, P3, A4] Able to implement and present quality data processing results.	
STUDY MATERIALS		
• Introduction; signals and systems • Basic concepts of digital data analysis • Fourier transform, Fourier analysis of analog functions • The fourier transform is fast and discrete • Sampling theory and applications • Convolution theory and applications • Correlation theory and applications • Filter theory and applications		

PRECONDITION
Mathematical Geophysics
REFERENCES
1. Keilis-Borok (auth.), VI Keilis-Borok, Edward A. Flinn (eds.)-Computational Seismology-Springer US (1995) 2. Clearbout, J.F.; Fundamentals of Geophysical Data Processing With Applications to Petroleum Prospecting. Mc. Graw-Hill Book Co., New York, 1976. 3. Sheriff, RE, and Geldart, LP; Exploration Seismology Vol.2: Data Processing and Interpretation. Cambridge University Press, 1983. 4. Oram Brigham B.: The Fast Fourier Transform and Its Applications. Prentice-Hall Inc., 1988.

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
Course	**Course Name**	**Well Log Data Analysis**
	Course Code	**CF234417**
	Credit	**3 (Three)**
	Semester	**4 (Four)**
COURSE DESCRIPTION		
This course studies the basic science and engineering of subsurface knowledge of drilling wells, the methods used, the acquisition of these methods, data processing from acquisition, to the interpretation of drill holes based on the methods used, both lithology and fluids, with the main aim being to formation evaluation.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply procedural processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data starting from identifying, formulating, analyzing and finding the source of problems, proposing the best solutions to solve problems, designing and operationalizing processes, processing systems and hardware and software equipment needed in existing geophysical engineering designs, local, national resources and engineering design and analysis tools that are most suitable, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account factors law, economics, environment, socio-cultural, political, health, public safety, culture,and sustainable development.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Students are able to apply the basic concepts of rock petrophysics with their respective physical characteristics and properties to subsurface conditions	
CLO-2	Students are able to implement the results of methods for measuring physical rock properties to interpret subsurface conditions such as lithology or volumetrics of a rock layer below the surface	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C2, A3] Students are able to explain the basics of rocks and petrophysics including fluids, such as their composition (minerals) and physical properties such as porosity, permeability, saturation, etc.	
Sub CLO-2	[C3, P3, A4] Students are able to explain geophysical methods in well-logging such as Gamma Ray, Resistivity, Neutron-Density, Sonic, Spontaneous, etc.	

Sub CLO-3	[C3, P3, A4] Students are able to explain and calculate the values of physical rock parameters based on well-log data, such as determining and calculating the values of porosity, permeability, saturation for each wellbore, and also interpreting subsurface conditions
Sub CLO-4	[C3, P3, A4] Students are able to interpret and correlate several well holes based on well-log data and obtain subsurface geological models such as (lithology, stratigraphic facies, subsurface structure).

STUDY MATERIALS

1. Basic introduction to Pertophysics
2. Basics of rock physics and properties
3. Basics of well-logging measurement methods
4. well-logging data acquisition
5. processing and calculating the physical properties of rocks
6. subsurface analysis using well-loG data
7. structural and stratigraphic analysis using well-log data, subsurface models (formation evaluation) using well-log data.

PRECONDITION

Rock Physics

REFERENCES

1. Darling, T., “Well Logging and Formation Evaluation”, Elsevier Inc., 2000
2. Tiab, D. and Donaldson, E.C., “Petrophysics 2nd.”, Elsevier, 2004.
3. Journal Of Petroleum Geologists

Supporters:

1. Asquith, GB And Krygowski, D., “Basic Well Log Analysis, 2nd”, American Association of Petroleoum Geologists, 2004.
2. Rider, M., “The Geological Interpretation of Well Logs, 2nd”, Rider-French Consulting Ltd., 2002.
3. Asquith, GB And Gibson, CR, “Basic Well Log Analysis for Geologists”, American Association of Petroleoum Geologists, 1982.
4. AAPG and IPA proceedings articles
5. Geophysical Journal

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
Course	**Course Name**	**Geotechnical**
	Course Code	**CF234418**
	Credit	**3 (Three)**
	Semester	**4 (Four)**
COURSE DESCRIPTION		
Soil classification, soil physical and mechanical parameters, soil compaction and slope stability calculations using analytical and auxiliary programs, concepts, survey design, data processing results and interpretation of geophysical methods in the case of river dams and embankments, highways, landfills, tunnels and offshore buildings .		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data procedurally starting from identifying, formulating, analyzing and finding the source of the problem, proposing the best solution to solve the problem, designing and operationalizing the process, processing systems and hardware and software equipment required in existing geophysical engineering designs, local and national resources as well as engineering design and analysis tools that are most appropriate, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account factors law, economics, environment, socio-cultural, political, health, public safety, culture,and sustainable development.	
COURSE LEARNING OUTCOMES (CLO)		
CLO1	Able to explain the concept of soil mechanics andprinciples of geophysical methods.	
CLO2	Able to implement geotechnical methods procedurally.	
CLO3	Able to implement geophysical methods procedurally starting from data search, processing, subsurface geology and modeling to solve in-depth geotechnical problems.	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub-CLO1	[C2,A3] Able to classify soil and explain the concept of soil physical and mechanical parameters and soil compaction.	
Sub-CLO2	[C4,P3,A4] Able to calculate slope stability using analytics and auxiliary programs.	
Sub-CLO3	[C4,P3,A4] Able to implement geotechnical methods procedurally.	

Sub-CLO4	[C2,A3] Able to explain the concepts and principles of geophysical methods for the construction and monitoring of embankments, roads, landfills, tunnels and offshore
Sub-CLO5	[C4, P3, A4] Able to implement geophysical methods for the construction and monitoring of embankments, highways, landfills, tunnels and offshore

STUDY MATERIALS

1. Soil Mechanics: soil classification, soil physical and mechanical parameters, soil compaction and slope stability calculations.
2. Application of Geophysical methods in geotechnical problems: Concept, survey design, data processing results and interpretation in the case of river dams and embankments, highways, landfills, tunnels and offshore buildings.

PRECONDITION

Geophysical Data Modeling and Rock Physics

REFERENCES

1. Braja M. Das (2021) Principles of Geotechnical Engineering, Cengage Learning, Stanford, USA.
2. Braja M. Das (2016), Principles of Foundation Engineering, Cengage Learning, Boston, USA.
3. Barker RD, Butcher AP, Culshaw MG, Jackson PD, McCann DM, Skipp BO, Matthews SL, Arthur JCR (2002), Geophysics in engineering investigations, CIRIA, London.
4. Mark E. Everett, (2013), Near-Surface Applied Geophysics, Cambridge Press. London.
5. Ria AAS and Dwa Desa Warnana (2020), Residual Soil Behavior, ITB Press
6. American Society for Testing and Materials (ASTM) Volume 04.08, March 2005, Soil and Rock (I): D 420 - D 5611.
7. 7. American Society for Testing and Materials (ASTM) \Volume 04.09, April 2005, Soil and Rock (II): D 5714 - latest

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
Course	**Course Name**	**Geoelectrical Exploration**
	Course Code	**CF234419**
	Credit	**3 (Three)**
	Semester	**4 (Four)**
COURSE DESCRIPTION		
Geoelectricity is a geophysical method which aims to determine the electrical properties of rock layers below the ground surface by flowing electric current into the ground. This lecture will explain the concept of geoelectricity in several methods, namely Self Potential (SP), Resistivity and Induced Polarization (IP) and its application in hydrogeology, geotechnics, mining exploration, disasters and the environment. Students will gain experience in geoelectric exploration planning starting from planning, data acquisition, processing and interpretation of geoelectric data so that a basic understanding of concepts and techniques will help students compete in the world of work. Activities will be carried out in group work so that students can think critically and practice teamwork to achieve common goals.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data procedurally starting from identifying, formulating, analyzing and finding the source of the problem, proposing the best solution to solve the problem, designing and operationalizing the process, processing systems and hardware and software equipment required in existing geophysical engineering designs, local and national resources as well as engineering design and analysis tools that are most appropriate, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account factors law, economics, environment, socio-cultural, political, health, public safety, culture,and sustainable development.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Students are able to apply the concept of Geoelectric Methods (basic sciences, physical parameters and basic laws)	
CLO-2	Students are able to implement Geoelectric Methods procedurally starting from data search, processing, subsurface geology and modeling to solve in-depth problems	

SUB COURSE LEARNING OUTCOMES (SUB CLO)	
Sub CLO-1	[C4, P3, A3] Students are able to explain the basic concepts and principles of electricity and their relationship to the physical characteristics of rocks
Sub CLO-2	[C4, P3, A3] Students are able to implement the Geoelectric Exploration – Resistivity method procedurally
Sub CLO-3	[C4, P3, A3] Students are able to implement the Geoelectric Exploration method - Induced Polarization procedurally
Sub CLO-4	[C4,P3,A3] Students are able to implement the Geoelectric Exploration - Self Potential method procedurally

STUDY MATERIALS

- Introduction
- The principle of ohm's law in geoelectric methods
- Electrical Properties of Rocks
- The current electrode on the earth is layered
- Configuration Type
- Acquisition, processing and interpretation of 1D, 2D and 3D Geoelectrics
- Acquisition, processing and interpretation of the Self Potential (SP) Method
- Acquisition, processing and interpretation of Induzed Polarization (IP) Method

PRECONDITION

Geophysical Data Modeling, Mathematical Geophysics, Rock Physics, Geodynamics

REFERENCES

1. Telford, W., Geldart, L. P., Sheriff, R. E. (1976). Applied Geophysics. Cambridge Univ Press, Cambridge.
2. Zhdanov, MS, Keller, GV, The Geoelectrical Methods in Geophysical Exploration, Elsevier, 1994.
3. Geophysical Journal

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
Course	**Course Name**	**Electromagnetic Exploration**
	Course Code	**CF234420**
	Credit (SKS)	**3 (Three)**
	Semester	**4 (Four)**
COURSE DESCRIPTION		
This course explains kbasic concepts of electromagnetic fields (MT, CSAMT, VLF, GPR), basic principles of the Law of Electromagnetic Induction, Maxwell, magnetic transfers, electric transfers, far field, near field. The role of electromagnetic methods in the exploration of minerals, oil and gas and earth resources; type of source and receiver; Get to know low-frequency EM methods: magnetotelluric (MT, Control Source Audio Magnetotelluric (CSAMT), radio magnetotelluric (RMT), Very Low Frequency (VLF), Transient Electromagnetics (TEM), EM induction; Understand high-frequency EM methods: Ground-penetrating radar (GPR), Remote Sensing; low frequency EM practicum (VLF, TEM), high frequency EM laboratory (GPR), and examples of EM applications in geotechnical, mining, hydrogeological studies, earth crust studies, oil and gas and geothermal explorationThe course applies case method-project based learning.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain concepts, principles of geophysical methodology to create or modify models in solving complex geophysical engineering problems (complex geophysical engineering problems) in depth and procedurally by prioritizing concepts and principles of environmental conservation, occupational safety and health in the laboratory and field, principles and current issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply procedural processes or components of geophysical engineering methods starting from identifying, formulating, analyzing and finding the source of problems, proposing the best solutions to solve problems, designing and operationalizing processes, processing systems and equipment needed in existing geophysical engineering designs, utilizing resources local, national resources as well as engineering design and analysis tools that are most appropriate, effective and efficient in solving geophysical engineering problems in depth by taking into account legal, economic, environmental, socio-cultural, political, health, public safety, cultural and sustainable development factors development).	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to master the concepts and principles of mathematics and natural science for Electromagnetic Methods (GPR, VLF, and MT)	
CLO-2	Able to implement Electromagnetic Methods procedurally starting from data search, processing, subsurface geology and modeling to solve in-depth engineering problems.	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C2,A3] Be able to explain the basic concepts and principles of Electromagnetic Waves and their relationship to the physical characteristics of rocks	

Sub CLO-2	[C3, P3, A4] Able to explain concepts, process and interpret low frequency EM data: Very Low Frequency
Sub CLO-3	[C3, P3, A4] Able to explain concepts, process and interpret low frequency EM data: Magnetotelluric
Sub CLO-4	[C3, P3, A4] Able to explain concepts, process and interpret high frequency EM data: Ground Penetrating Radar

STUDY MATERIALS

- **Basic concepts of electromagnetic waves**: wave properties, physical and mathematical principles for electric and magnetic fields.
- **Electromagnetic exploration management**procedurally: Concept, survey design with 1D-2D, data processing and interpretation.
- **Application of EM methods in the earth field:**Writing scientific reports with integration of EM method data and geological conditions, map standards and geophysical cross sections.

PRECONDITION

Geophysical Data Modeling, Mathematical Geophysics, Rock Physics, Geodynamics

REFERENCES

1.Telford, W., Geldart, LP, Sheriff, RE (1976). Applied Geophysics. Cambridge Univ Press, Cambridge.
2. Zhdanov, MS (2009). Geophysical Electromagnetic Theory and Methods. Elsevier.
3. Simpson, F. and Bahr, K. (2005). Practical Magnetotelluric. Cambridge.
4. Griffiths, DJ (1999). Introduction to Electrodynamics, 3rd ed., Prentice Hall.
5. Journal of Geophysics
6. Google Scholar Wien Lestari:https://scholar.google.co.id/citations?user=_wrH5DsAAAAJ&hl=en

Journal Paper for Citations:

1. Identification of Soil Contamination Using VLF-EM and Resistivity Methods : A Case Study (http://iptek.its.ac.id/index.php/jts/article/view/5004)

Seminar Paper for Citation:

1. Mapping of Kendeng Thrust Active Fault in East Java Using Magnetotelluric Method(https://www.earthdoc.org/content/papers/10.3997/2214-4609.201800424)
2. Earthquake Risk Reduction Study with Mapping an Active Fault at The Southern of East Java(https://iopscience.iop.org/article/10.1088/1742-6596/1373/1/012031/meta)
3. Earthquake Potential Source Identification using Magnetotelluric Data of Kendeng Thrust Surabaya Area(https://www.e3s-conferences.org/articles/e3sconf/abs/2020/16/e3sconf_iceedm2020_01002/e3sconf_iceedm2020_01002.html)
4. Active Fault Delineation Using Magnetotelluric Data in The Western Region of East Java(https://iopscience.iop.org/article/10.1088/1755-1315/506/1/012054/meta)
5. Identification of geothermal systems based on 1D, 2D, 3D inversion and TDEM static shift correction study case Mt. Arjuno-Welirang, East Java(https://aip.scitation.org/doi/abs/10.1063/5.0015771)
6. Application of empirical mode decomposition (EMD) filtering at magnetotelluric time-series data(https://aip.scitation.org/doi/abs/10.1063/5.0015767)

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Digital Electronics**
	Course Code	**CF234426**
	Credit	**2 (Two)**
	Semester	**4 (Four)**
COURSE DESCRIPTION		
The Digital Electronics course aims to sharpen students' skills in understanding and implementing digital circuit-based device applications.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain concepts, principles of geophysical methodology to create or modify models in solving complex geophysical engineering problems (complex geophysical engineering problems) in depth and procedurally by prioritizing concepts and principles of environmental conservation, occupational safety and health in the laboratory and field, principles and current issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply processes or components of geophysical engineering methods procedurally starting from identifying, formulating, analyzing and finding the source of problems, proposing the best solutions to solve problems, designing and operationalizing processes, processing systems and equipment required in existing geophysical engineering designs, utilizing resources local, national resources as well as the most appropriate, effective and efficient engineering design and analysis tools in solving geophysical engineering problems in depth by taking into account legal, economic, environmental, socio-cultural, political, health, public safety, culture and sustainable development factors. development).	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to explain the application of digital circuit-based devices	
CLO-2	Able to implement digital circuit-based device applications.	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub-CLO1	[C2,A3] Be able to explain the basics of digital circuits	
Sub-CLO2	[C4,P3,A4] Be able to make digital circuits with combinational gates	
Sub-CLO3	[C4,P3,A4] Be able to make combinational gate circuitsEncoder & Decoder , Multiplexer and Demultiplexer	
Sub-CLO4	[C4,P3,A4] Able to apply combinational digital circuits	
STUDY MATERIALS		
This course discusses the basics of digital electronics circuits. Topics discussed include how and properties of basic combinational gates (AND, OR, NOT, NAND, NOR, EXOR), creating digital circuits with combinational gates, Boolean theorem, Canonical functions, simplifying circuits with K-Map, Substitution circuits with NAND and NOR, Applications of combinational digital circuits: Basic Arithmetic circuits, Parity Generators and Checkers, Comparators, Encoders & Decoders, Multiplexers and Demultiplexers		
REQUIREMENTS		
Basic Electronics		

REFERENCES
1. Tokheim, R., 2013, Digital Electronics, 8th Edition, McGraw-Hill 2. Tocci, RJ, Widmer, NS, and Moss, GL, 2017, Digital Systems: Principles and Applications 12th Edition, Pearson Education Prentice Hall, New York 3. Digital Electronics Practical Module

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Rock Mechanics**
	Course Code	**CF234427**
	Credit	**2 (Two)**
	Semester	**4 (Four)**
COURSE DESCRIPTION		
This lecture explains the basics of rock mechanics in relation to geophysics and applies them in the interpretation of geophysical data		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain concepts, principles of geophysical methodology to create or modify models in solving complex geophysical engineering problems in depth and procedurally by prioritizing concepts and principles of environmental preservation, occupational safety and health in laboratories and fields, principles and current issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply processes or components of geophysical engineering methods procedurally starting from identifying, formulating, analyzing and finding the source of problems, proposing the best solutions to solve problems, designing and operationalizing processes, processing systems and equipment required in existing geophysical engineering designs, utilizing resources local, national resources as well as the most appropriate, effective and efficient engineering design and analysis tools in solving geophysical engineering problems in depth by taking into account legal, economic, environmental, socio-cultural, political, health, public safety, culture and sustainable development factors. development).	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to explain the basics of rock mechanics	
CLO-2	Able to implement rock mechanics in the interpretation of geophysical data	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub-CLO1	[C2,A3] Be able to explain the principles and behavior of rocks	
Sub-CLO2	[C2,A3] Able to explain rock classification	
Sub-CLO3	[C2, A3] Be able to explain the stress distribution around the tunnel	
Sub-CLO4	[C4,P3,A4] Able to apply the mechanical properties of rocks in geophysical interpretation	
STUDY MATERIALS		
This course discusses rock mechanisms, principles of rock mechanics, various types of rock behavior, ways to determine stress distribution around tunnels, and rock mass classification.		
REQUIREMENTS		
Rock Physics		

REFERENCES
1.George H. Davis, Stephen J. Reynolds, Charles F. Kluth, Structural Geology of Rocks and Regions, 3rd Edition, Wiley Blackwell, 2012 2. Fossen Haakon, Rock Mechanics, Cambridge University Press, 2016 3. Rai, MA, 1988, Rock Mechanics, Geotechnical Laboratory, PAU-Engineering Sciences, ITB Bandung

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER **FACULTY OF CIVIL PLANNING AND GEO ENGINEERING** **GEOPHYSICAL ENGINEERING DEPARTMENT** **UNDERGRADUATE PROGRAM STUDY**	
Course	**Course Name**	**Petroleum Geology**
	Course Code	**CF234428**
	Credit	**3 (Three)**
	Semester	**3 (Three)**

COURSE DESCRIPTION

This course studies an outline of a petroleum system which includes aspects of source rock and maturation, aspects of reservoir rocks and their physical properties, aspects of hydrocarbon migration, entrapment, and their rock caps. This course also discusses examples of basins in Indonesia/oil and gas fields in Indonesia that have the potential for further exploration of hydrocarbons.

PROGRAM LEARNING OUTCOMES (PLO)	
PLO-4	Able to explain the principles of mathematics, natural science, geology, geospatial, instrumentation, information technology, engineering principles and design into geophysical engineering procedures, processes, systems or methodologies.
COURSE LEARNING OUTCOMES (CLO)	
CLO-1	Able to apply the concept of a petroleum system in an oil and gas field, including the concept of all its elements such as source rock, reservoir, cap system, migration and trap
CLO-2	Able to implement the petroleum system concept for several regions in Indonesia
SUB COURSE LEARNING OUTCOMES (SUB CLO)	
Sub CLO-1	[C2,A3] Able to understand the concept of petroleum systems
Sub CLO-2	[C3,P3,A4] Be able to explain the elaboration of a petroleum system concept in an oil and gas field
Sub CLO-3	[C3, P3, A4] Able to process data from mapping results in oil and gas fields with certain geological conditions
Sub CLO-4	[C3, P3, A4] Able to understand and look for good petroleum systems in several oil and gas fields in Indonesia

STUDY MATERIALS

1. Basic introduction to starting oil and gas/hydrocarbons
2. The concept of their formation and accumulation in nature
3. Concept of each aspect in the Petroleum system
4. How to search for hydrocarbons/exploration
   Implementation of oil and gas fields in Indonesia

REQUIREMENTS

Structural Geology

REFERENCES

1. North FK (1985), Petroleum Geology Allen & Unwin, London, Sydney
2. Magoon B.and Dow G. AAPG memoir no.60 1994: The Petroleum System from Source to Trap
3. AAPG and IPA Proceedings
4. Koesoemadinata, 1984. Geology of Oil and Gas. Department of Geological Engineering ITB
5. Selley, R (1989) Elements of Petroleum Geology
6. Levorsen, AI (2017) Petroleum of Geology

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Petromagnetics**
	Course Code	**CF234429**
	Credit	**2 (Two)**
	Semester	**4 (Four)**
COURSE DESCRIPTION		
This course studies petromagnetic data analysis in the field of geophysical engineering		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data procedurally starting from identifying, formulating, analyzing and finding the source of the problem, proposing the best solution to solve the problem, designing and operationalizing the process, processing systems and hardware and software equipment required in existing geophysical engineering designs, local and national resources as well as engineering design and analysis tools that are most appropriate, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account factors law, economics, environment, socio-cultural, political, health, public safety, culture,and sustainable development.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to explain about geomagnetism and the basics of petromagnetism	
CLO-2	Be able to explain about magnetic susceptibility	
CLO-3	Be able to explain about remanent magnetization	
CLO-4	Able to process and analyze petromagnetic data	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	Able to explain about geomagnetism and the basics of petromagnetism	
Sub CLO-2	Be able to explain about magnetic susceptibility	
Sub CLO-3	Be able to explain about remanent magnetization	
Sub CLO-4	Able to process and analyze petromagnetic data	
STUDY MATERIALS		
1. Geomagnetism 2. Petromagnetic basis 3. Magnetic susceptibility 4. Remanent magnetization		

REQUIREMENTS
Exploration of Gravity and Magnetism
REFERENCES
1. Dunlop and Odzemir, “Rock Magnetism” 2. Evans and Heller, “Environmental Magnetism” 3. Tauxe, "Paleomagnetism" 4. Journal article on petromagnetism

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Thermodynamics**
	Course Code	**CF234443**
	Credit	**2 (Two)**
	Semester	**4 (Four)**
COURSE DESCRIPTION		
This course discusses laws of thermodynamics one to three which include the concepts of temperature, heat, internal energy, work, equilibrium, enthalpy, entropy, Carnot cycle, Helmholtz and Gibbs free energy, phase diagrams and applications of thermodynamics in geoscience		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to explain thermodynamics as a basic science in science and engineering	
CLO-2	Able to explain basic concepts and laws of thermodynamics and their application to geoscience	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	Able to explain the laws, basic concepts and role of thermodynamics	
Sub CLO-2	Able to explain the temperature - pressure relationship and phase diagrams	
Sub CLO-3	Able to apply the laws of thermodynamics in completing case studies in geoscience	
Sub CLO-4	Able to explain the basic concepts of thermodynamics which include systems, properties, temperature relationships and physical parameters, enthalpy, entropy, thermodynamic laws and their applications in thermodynamic systems	
STUDY MATERIALS		
• Introduction • The concept of thermodynamics • First law of thermodynamics • Enthalpy • Second law of thermodynamics • Entropy • Carnot cycle • The third law of thermodynamics • Equilibrium • Gibbs energy		

- Temperature - pressure
- Reversible and irreversible
- Case study

REQUIREMENTS

Calculus 2

REFERENCES

1. Thermodynamics of Natural Systems, Second Edition, GM Anderson, University of Toronto, Cambridge University Press, 2005
2. Fundamentals of Thermodynamics, Claus Borgnakke, University of Michigan, John Wiley & Sons, 2013
3. Thermodynamics Fundamentals and Engineering Applications, William C. Reynolds, Stanford University, Cambridge University Press, 2018
4. Related journals

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Geostatistics**
	Course Code	**CF234444**
	Credit	**2 (Two)**
	Semester	**4 (Four)**
COURSE DESCRIPTION		
This course explains various parameters of a geoscience object based on regional variable theory through variogram structure analysis and estimating the volume of a reserve using geostatistical methods.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to master the concept of data variation and estimation in estimating a reserve volume	
CLO-2	Able to process data, analyze case studies and review developments in geostatistics applications in the field of geoscience	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	Able to explain conventional reserve calculations and basic geostatistical concepts based on data distribution	
Sub CLO-2	Able to create experimental variograms, determine variogram models and geostatistical parameters	
Sub CLO-3	Able to explain the use of extension and estimation variances in estimating reserves, geometric relationships between samples and the estimated quantities	
Sub CLO-4	Able to study the development of geostatistics applications in the field of geoscience	
Sub CLO-5	Able to calculate reserve volume	
STUDY MATERIALS		
Basic statistics, conventional and geostatistical calculation methods, variogram analysis and modeling, dispersion variance, extension variance, estimation variance, Krigging, reserve estimation and case studies in geoscience		
REQUIREMENTS		
Calculus I, Structural Geology		

REFERENCES

1. David, M., “Geostatistical Ore Reserve Estimation, Developments in Geomathematics 2”, Elsevier Scientific Publishing Co., Amsterdam, Oxford-New York, 1980 Matheron, G., “Principles of Geostatistics”, Economic Geology vol.58, 1963
2. Annels, Alwyn E., "Mineral Deposit Evaluation", A practical approach, Chapman and Hall, London, 1991.
3. Wellmer, Friedrich, Statistical Evaluations in Exploration for Mineral Deposits, Springer, Germany, 1998
4. Clark, I., Practical Geostatistics, Applied Science Publishers Ltd., London, 1979
5. Related journals

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Geographic Information System**
	Course Code	**CF234445**
	Credit	**2 (Two)**
	Semester	**4 (Four)**
COURSE DESCRIPTION		
This course studies petromagnetic data analysis in the field of geophysical engineering		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Capableidentifying the source of the problem, formulating alternative solutions, analyzing the appropriate information and computing based technology in solving the problemwith Geographic Information Systems	
CLO-2	Capableorganize data and present it again by utilizing information technology according to their needs with a Geographic Information System	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C4,P4,A4] Able to use and process GPS data	
Sub CLO-2	[C4,P4,A4] Able to use and process drone data	
Sub CLO-3	[C4,P3,A3] Be able to explain the basic concepts and principles of Geographic Information Systems	
Sub CLO-4	[C4,P3,A3] Able to apply geographic information technology in the field of Geophysics	
Sub CLO-5	[C4,P3,A3] Able to explain the implementation of geophysical engineering problems in the earth field with GIS and present it in scientific writing and communication	
STUDY MATERIALS		
1. Understanding Geographic Information Systems 2. GPS data usage and processing 3. Use and processing of Drone data 4. The use and method of processing satellite images 5. GIS application in geophysics 6.		
REQUIREMENTS		
Mapping		

REFERENCES

1. Gorr, WL and KS Kurland, 2008, GIS Tutorial Basic Workbook, ESRI Press
2. Rolf, A. (editor), 2001, Principles of Geographic Information Systems, ITC Educational Textbook Series, ITC Enschede, The Netherlands
3. Christman, N., 1997, Exploring Geographic Information Systems, John Wiley and Sons, New York
4. GIS practical module
5. Geophysical Journal

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Seismic Data Interpretation**
	Course Code	**CF234530**
	Credit	**2 (Two)**
	Semester	**5 (Five)**
COURSE DESCRIPTION		
This course explains the basic concepts of seismic data acquisition and its evaluation, selecting good quality seismic sections that can be interpreted well. Students are able to understand seismic data processing procedures so that if in the course of interpreting seismic data there are errors in the acquisition or processing process, errors in interpretation can be minimized properly. The course applies case method-project based learning.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data procedurally starting from identifying, formulating, analyzing and finding the source of the problem, proposing the best solution to solve the problem, designing and operationalizing the process, processing systems and hardware and software equipment required in existing geophysical engineering designs, local and national resources as well as engineering design and analysis tools that are most appropriate, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account factors law, economics, environment, socio-cultural, political, health, public safety, culture,and sustainable development.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to apply the concept of subsurface mapping with geophysical methods or integration with geological methods	
CLO-2	Able to analyze and identify the results of subsurface mapping and select good data quality	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C4,P3,A3] Be able to explain the basic concept of Subsurface Map	
Sub CLO-2	[C4,P3,A3] Able to implement concepts/procedures in seismic data acquisition or processing	
Sub CLO-3	[C4,P3,A3] Able to choose good data quality for identification or integration of geophysical data or geological data	
Sub CLO-4	[C4,P3,A3] Able to evaluate data for better interpretation	

STUDY MATERIALS
• Basin Analysis • Seismic data acquisition • Seismic Data Processing • Interpretation of qualitative and quantitative seismic data • Structural interpretation • Stratigraphic Interpretation • Well Seismic Tie • Seismic Inversion • Seismic attributes • Reservoir identification and evaluation
REQUIREMENTS
Seismic Exploration Well-Log Data Analysis
REFERENCES
1. Brown, A., “Interpretation of Three-Dimensional Seismic Data”, American Association of Petroleum Geologists, 2004. 2. Sheriff, RE, Exploration Seismology, Cambridge Univ. Press. 1995. 3. Avseth, P., Mukerji, T., and Mavko, G., “Quantitative Seismic Interpretation”, Cambridge University Press., 2005. 4. Thorne Lay, Terry C. Wallace-Modern Global Seismology, Vol. 58-Academic Press,1995. 5. Journal of Geophysics and Proceedings of AAPG and IPA

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Passive Seismic Exploration**
	Course Code	**CF234531**
	Credit	**2 (Two)**
	Semester	**5 (Five)**
COURSE DESCRIPTION		
This course explains the use of sourceless or passive seismic waves such as in the areas of exploration and monitoring of hydrocarbon reservoirs, exploration and monitoring of geothermal reservoirs, as well as the use of passive seismic waves to describe the structure of the earth globally either by utilizing earthquake waves or ambient noise by utilizing interferrometry techniques. .		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply procedural processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data starting from identifying, formulating, analyzing and finding the source of problems, proposing the best solutions to solve problems, designing and operationalizing processes, processing systems and hardware and software equipment needed in existing geophysical engineering designs, local, national resources and engineering design and analysis tools that are most suitable, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account factors law, economics, environment, socio-cultural, political, health, public safety, culture,and sustainable development.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to explain the concepts and principles of passive seismic exploration methods.	
CLO-2	Able to implement passive seismic exploration methods procedurally starting from data search, processing, subsurface geology and modeling to solve in-depth problems.	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C3, P3, A3] Able to explain the phenomenon of naturally occurring seismic waves caused by fluid movement in hydrocarbon and geothermal reservoirs	
Sub CLO-2	[C3, P3, A3] Be able to explain the types of equipment used as passive seismic wave vibration recorders	

Sub CLO-3	[C3, P3, A3] Able to carry out measurements and data processing using passive seismic methods to obtain an overview of subsurface conditions, both in the form of reservoirs and non-reservoirs.
Sub CLO-4	[C3, P3, A3] Able to analyze geological phenomena and processes that occur based on interpretation of passive seismic method data.

STUDY MATERIALS

- Introduction,
- Surface waves
- Passive seismic wave recording instrument
- Geophone and its types
- Seismic interferrometry
- Microtremor
- SASW and MASW
- Passive Seismic Tomography

REQUIREMENTS

Seismic Exploration

REFERENCES

1. Landsberg, HE, 1955, Principles and Applications of Microearthquake Methods, Academic Press,
2. Kayal, JR, 2008, Microearthquake Seismology and Seismotectonics of South Asia, Springer, US
3. Okada, H., Suto, K., 2003, The Microtremor Survey Method Geophysical Monograph Series, Society of Exploration Geophysicists.
4. Schuster, GT, 2009, Seismic Interferometry, Cambridge University Press
5. Verdon, JP, 2012, Microseismic Monitoring and Geomechanical Modeling of CO2 Storage in Subsurface Reservoirs, Springer-Verlag Berlin Heidelber
6. National and international Geophysical Journals - indexed

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Geophysical Instrumentation**
	Course Code	**CF234532**
	Credit	**2 (Two)**
	Semester	**5 (Five)**
COURSE DESCRIPTION		
This course studies the working principles of instrumentation and the application of electronic instrumentation related to geophysical methods		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply procedural processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data starting from identifying, formulating, analyzing and finding the source of problems, proposing the best solutions to solve problems, designing and operationalizing processes, processing systems and hardware and software equipment needed in existing geophysical engineering designs, local, national resources and engineering design and analysis tools that are most suitable, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account factors law, economics, environment, socio-cultural, political, health, public safety, culture,and sustainable development.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Students are able to apply the concept of the petroleum system to an oil and gas field, including the concept of all its elements such as source rock, reservoir, cap system, migration and traps	
CLO-2	Students are able to implement the petroleum system concept for several regions in Indonesia	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C2,A3] Able to explain the basic concepts of instrumentation systems	
Sub CLO-2	[C2,A3] Able to explain the concept and application of operational amplifiers	
Sub CLO-3	[C2,A3] Be able to explain the concept and application of sensors and transducers	
Sub CLO-4	[C2,A3] Be able to explain the application of instrumentation in the use of geophysical method equipment	

STUDY MATERIALS
1. Basic concept of instrumentation system 2. Operational Amplifiers 3. Sensors and transducers 4. Instrumentation of geophysical measurement equipment
REQUIREMENTS
Basic Electronics
REFERENCES
1. Sedra & Smith, "Microelectronic Circuits Sixth Edition", Oxford University Press 2. Maik Schmidt, "Arduino A Quick-Start Guide", The Pragmatic Bookshelf

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Earthquake Engineering**
	Course Code	**CF234533**
	Credit	**3 (three)**
	Semester	**5 (Five)**

COURSE DESCRIPTION

Re-introduction of the causes of tectonic, magmatic earthquakes and earthquake intensity, tectonic plate earthquake pathways, distribution of epicenters, seismicity. Damages caused by earthquakes, understanding of measuring earthquake intensity. How many types of ground motion measurement methods are there, such as the Murphy-O Brien, Gutenberg-Richter, Kanai methods, etc. Analysis of earthquake disasters. Local soil types and how earthquake waves affect alluvial soil, granite soil, etc. Classification of soil types based on their natural dominant period, classification of surface soil according to: Kanai, S. Omate and N. Nakajima soil structure and period distribution curves on dense, soft and very soft soils. Some examples of seismic zoning include: seismicity index, cumulative seismic hazard index, average regional seismic hazard index and value b. Forces due to earthquakes on buildings with various seismic coefficients. Acceleration and attenuation of seismic waves in subduction/crust and fault zones. Statistical analysis of earthquake disasters and deterministic analysis of earthquake disasters.

PROGRAM LEARNING OUTCOMES (PLO)

PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.
PLO-6	Able to apply procedural processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data starting from identifying, formulating, analyzing and finding the source of problems, proposing the best solutions to solve problems, designing and operationalizing processes, processing systems and hardware and software equipment needed in existing geophysical engineering designs, local, national resources and engineering design and analysis tools that are most suitable, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account factors law, economics, environment, socio-cultural, political, health, public safety, culture,and sustainable development.

COURSE LEARNING OUTCOMES (CLO)	
CLO-1	Able to understand the concept of seismology and apply it in the field of engineering and collaborate with other multidisciplinary sciences
CLO-2	Able to study the implications of applied seismology in making seismic hazard maps with a current method approach
SUB COURSE LEARNING OUTCOMES (SUB CLO)	
Sub CLO-1	[C4,P3,A4] Able to explain the concept of applied seismology and its development in engineering with various other disciplines.
Sub CLO-2	[C4,P3,A4]Able to study the implications of applied seismology in making Probabilistic Seismic Hazard Analysis maps
Sub CLO-3	[C4,P3,A4]Able to study the implications of applied seismology in making Deterministic Seismic Hazard Analysis maps
Sub CLO-4	[C4,P3,A4]Able to study the implications of applied seismology in making Microtremor maps and Downhole Seismic Surveys
STUDY MATERIALS	
Introduction, Seismic Hazard, Ground Motion, Earthquake acceleration, Seismic Zoning, Local soil influence, Force due to earthquakes, Probabilistic Seismic Hazard Analysis, Deterministic Seismic Hazard Analysis, Microtremor and Downhole seismic survey	
REQUIREMENTS	
Seismology	
REFERENCES	
1. Maugeri, M, 2014, Earthquake Geotechnical Engineering Design, GEOTECHNICAL, GEOLOGICAL AND EARTHQUAKE ENGINEERING, Volume 28, Springer, London. 2. AKKAR, S., 2011, EARTHQUAKE DATA IN ENGINEERING SEISMOLOGY GEOTECHNICAL, GEOLOGICAL AND EARTHQUAKE ENGINEERING, Volume 14, Springer, London. 3. Yoshida, N., 2015, Seismic Ground Response Analysis, GEOTECHNICAL, GEOLOGICAL AND EARTHQUAKE ENGINEERING, Volume 36, Springer, London	

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Marine Geophysics**
	Course Code	**CF234534**
	Credit	**2 (Two)**
	Semester	**5 (Five)**
COURSE DESCRIPTION		
This course studies the basic concepts and theories of marine geophysical survey methods and the application of geophysical data in the interpretation of geology beneath the seabed.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply procedural processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data starting from identifying, formulating, analyzing and finding the source of problems, proposing the best solutions to solve problems, designing and operationalizing processes, processing systems and hardware and software equipment required in existing geophysical engineering designs, local, national resources and engineering design and analysis tools that are most appropriate, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account legal, economic, environmental, socio-cultural, political, health factors , public safety, culture and sustainable development.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to explain the basics of standard marine geophysical mapping	
CLO-2	Able to apply marine geophysical methods and data in the interpretation of subseabed geology	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C3,A2] Be able to explain the principles of the Sonar, Lidar, Echosounder methods, and potential geophysical methods (Gravity and magnetic) for mapping under the seabed	
Sub CLO-2	[C3,A2] Able to explain the principles of single and multi-channel seismic methods for subseabed mapping	
Sub CLO-3	[C4,P3,A4] Able to apply Sonar, lidar, Echosounder methods, and potential geophysical methods (Gravity and magnetic) for interpretation of subseabed mapping	
Sub CLO-4	[C4,P3,A4] Able to apply single and multi-channel seismic methods for interpretation of subseabed mapping	

STUDY MATERIALS
• Fundamentals of marine geology and geophysics standard mapping • Mapping the seabed with sonar, lidar and echosounder • Mapping under the seabed using Gravity, magnetic, single channel seismic and multi channel seismic methods • Interpretation of underwater geology from gravity, magnetic, single channel seismic and multi channel seismic methods
REFERENCES
1. WM Telford, LP Geldart & RE Sheriff (1990). Applied Geophysics. Cambridge University Press. 2. P. Kearey, M. Brooks & I. Hill (2002). An Introduction to Geophysical Exploration. Blackwell. 3. EJW Jones (1999). Marine Geophysics. Wiley. 4. Geophysics Journal
REQUIREMENTS
Geodynamics, Geoelectric Exploration, Seismic Exploration, EGBM Exploration, EM Exploration

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Global Geophysical Insight**
	Course Code	**CF234535**
	Credit	**2 (Two)**
	Semester	**5 (Five)**
COURSE DESCRIPTION		
Courses that focus on interdisciplinary processes, problems and topics to understand globalization. Students learn to define problems within the framework of global issues, integrate information from various disciplines, deal with complex problems and apply creative and critical thinking, use a variety of methods and approaches in analyzing		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-2	Able to study and utilize science and technology in order to apply it to the field of geophysical engineering, and be able to make appropriate decisions from the results of their own work or group work in the form of final project reports or other forms of learning activities whose output is equivalent to the final project through logical, critical thinking , systematic and innovative.	
PLO-3	Able to manage one's own learning, and develop oneself as a lifelong learner to compete at national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to sustainability principles and understanding technology-based entrepreneurship.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to apply basic science principles of geophysical engineering in identifying problem sources, formulating solutions, analyzing appropriate information and computing technology in completing the final assignment procedurally with the principles of benefit and sustainability.	
CLO-2	Able to make the right decisions and be responsible for the results of the final assignment and convey them using information technology and effective communication techniques orally and in writing.	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C4, P3, A3] Able to increase, broaden and strengthen students' skills in applying geophysical and non-geophysical exploration methods as a basic experience to enter the world of work in accordance with the study expertise they are undertaking, growing, developing and strengthening professional attitudes and as preparation beginning for the final task / thesis.	
Sub CLO-2	[C4, P3, A3] Able to organize data and present it again by utilizing information technology that suits their needs;	
Sub CLO-3	[C4, P3, A3] Able to criticize complete operational procedures in solving geophysical engineering technology problems that have been and/or are being implemented, and expressed in the form of scientific working papers and presentations.	
Sub CLO-4	[C4, P3, A3] Able to work together to make maximum use of their potential and be responsible for achieving work results.	
STUDY MATERIALS		
The subject matter in this course is adjusted to their respective fields of study		

REQUIREMENTS
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REFERENCES
1. Text book/ module according to the field of study 2. Journals and Proceedings 3. Indexed international and national journals.

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Internship**
	Course Code	**CF234536**
	Credit	**3 (Three)**
	Semester	**5 (Five)**
COURSE DESCRIPTION		
Students carry out comprehensive and procedural research activities includingidentify the source of the problem, formulate alternative solutions using geological and geophysical science and knowledge, analyze appropriate information and computing technology-based analysis in solving geophysical engineering problems. Students understandthe importance of developing professional competencies, knowing the latest developments - contemporary issues relevant to the development of earth science and technology through literature studies, applying science and technology in the context of developing lifelong learning and having a sustainable development perspective. Besides that,encourage students to think critically,internalized the ability to take responsibilityon the research process and results, discipline, internalizing academic values, norms and ethics for final project work as well as mastering information technology and effective communication techniques verbally and in writing based on scientific rules, procedures and ethics so that they can be of wider benefit to society.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-2	Able to study and utilize science and technology in order to apply it to the field of geophysical engineering, and able to make appropriate decisions from the results of one's own work or group work in the form of a final assignment report or other form of learning activity whose output is equivalent to the final assignment through logical, critical thinking , systematic and innovative.	
PLO-3	Able to manage self-learning, and develop oneself as a personal lifelong learner to compete at national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to the principles of sustainability and understanding technology-based entrepreneurship.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to identify the source of problems, formulate solutions, analyze information technology and computing in completing practical workwith the principles of benefit and sustainability,capableresponsible for the results of practical workand convey the results of practical work usinginformation technology and effective communication techniques orally and in writing.	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C4,P3,A3] Able to apply basic research concepts and conduct in-depth research on the procedural application of geophysical methods according to exploration stages (planning, acquisition, data processing, interpretation).	
Sub CLO-2	[C4, P3, A3] Able to organize data and present it again by utilizing information technology that suits their needs.	

Sub CLO-3	[C4, P3, A3] Able to criticize complete operational procedures in solving geophysical engineering technology problems that have been and/or are being implemented, and expressed in the form of scientific working papers and presentations.
Sub CLO-4	[C4, P3, A3] Able to work together to make maximum use of their potential and be responsible for achieving work results.

STUDY MATERIALS

- Geological Exploration Methods
- Survey design, processing, and interpretation/analysis of geophysical exploration methods: Seismic Method, Gravity and Magnetic Method, Geoelectric Method, Electromagnetic Method
- Geotomography

REQUIREMENTS

Seismic Exploration, Geoelectric Exploration, Electromagnetic Exploration, Gravity and Magnetic Exploration, Inversion Method, Structural Geology, Geotomography

REFERENCES

1. Telford et al., Applied Geophysics, Cambridge Univ. Press, 1976
2. Reynolds, J.M., An Introduction to applied and environmental Geophysics. John Wiley and Sons, 1997.
3. Sheriff, RE, and LP Geldart, Exploration Seismology. Cambridge Univ. Press, 1995.
4. Grant & West, Interpretation Theory in Applied Geophysics, Mc. Graw-Hill Book Company, 1965.3.
5. Billings, MP, 1982, Structural Geology, Prentice Hall, New Delhi.
6. Indexed international and national journals.

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Volcanology**
	Course Code	**CF234446**
	Credit	**2 (Two)**
	Semester	**4 (Four)**

COURSE DESCRIPTION

Basic understanding and history of the development of volcanology, volcanism and magmatism, volcanicity and tectonics, the appearance of symptoms of volcanism on the surface, the distribution of volcanoes in the world, the body structure of volcanoes, mechanisms and types of eruptions, eruption products, volcanism in Indonesia, the economic meaning and dangers of volcanic activity. This course applies the case learning method.

PROGRAM LEARNING OUTCOMES (PLO)	
PLO-4	Able to explain the principles of mathematics, natural science, geology, geospatial, instrumentation, information technology, engineering principles and design into geophysical engineering procedures, processes, systems or methodologies.

COURSE LEARNING OUTCOMES (CLO)	
CLO-1	Able to explain the concepts of magma formation and volcanism
CLO-2	Capableexplains the concept of volcanostratigraphy, volcanic hazards and resources

SUB COURSE LEARNING OUTCOMES (SUB CLO)	
Sub CLO-1	[C2,A3] Be able to explain the concept of magma formation
Sub CLO-2	[C2,A3] Be able to explain the concept of the volcanic eruption process
Sub CLO-3	[C2,A3] Able to apply the concept of volcanic eruption products as well as their transport and deposition processes
Sub CLO-4	[C2,A3] Be able to explain the dangers and resources of volcanoes

STUDY MATERIALS

- Introduction to volcanology
- Magma formation
- magma composition
- Types of volcanoes
- Magma properties and eruption triggers
- explosive eruption
- Effusive eruption
- Eruption products
- Volcaniclastic Rock
- Transport and depositional processes
- Volcanostratigraphy Survey
- Volcanic Hazards
- Volcano Monitoring
- Volcanic resources

REQUIREMENTS

Structural Geology

REFERENCES

1. Fisher, RV, and Schmincke, HU, 1984, Pyroclastic Rocks, Springer Verlag, Berlin Heidelberg.
2. McPhie, Doyle, J.M., and Allen. 1993, Volcanic Texture : A guide to the interpretation of textures in volcanic rocks, Center for Ore Deposit and Exploration Studies, University of Tasmania.
3. O'Meara, D., 2008, Volcano, a visual guide, Firely Books Inc., New York.
4. Payson, DS, and Grayson, DK, 1979, Volcanic Activity and Human Ecology, Academic Press, New York.

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Exploration Management**
	Course Code	**CF234547**
	Credit	**3 (Three)**
	Semester	**5 (Five)**
COURSE DESCRIPTION		
This course aims to provide knowledge of both management hard skills and soft skills in Geophysics Exploration activities.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-6	Able to apply processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data procedurally starting from identifying, formulating, analyzing and finding the source of the problem, proposing the best solution to solve the problem, designing and operationalizing the process, processing systems and hardware and software equipment required in existing geophysical engineering designs, local and national resources as well as engineering design and analysis tools that are most appropriate, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account factors law, economics, environment, socio-cultural, political, health, public safety, culture,and sustainable development.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	[C4,P4,A4] Able to apply and analyze a geophysical exploration activity with the aim of sustainability and efficiency (K3L) in exploration activities.	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C4, P4, A4] [Conceptual knowledge, Analyze] Able to understand and master the Basic Concepts of Exploration Management	
Sub CLO-2	[C4,P4,A4][Procedural knowledge, Analyze]:Mastering organizational concepts and geophysical exploration management systems (HR)	
Sub CLO-3	[C4, P4, A4][Procedural knowledge, Analyze]: Mastering the concept and application of leadership and Human Resources, mastering in organizing and managing Team Work	
Sub CLO-4	[C4,P4,A4][Procedural knowledge, Analyze]: Mastering the functions and planning processes of geophysical exploration	
STUDY MATERIALS		
Geophysical exploration management concepts and functions: HR management functions, exploration organizational concepts and systems, developing and managing work teams, leadership and human resources, planning functions and processes; Planning techniques and methods; Assess the feasibility of exploration/activities; Special topic.		
REQUIREMENTS		
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REFERENCES		
1. Brown W, Exploration in Management, a Pelican Book Publisher 2. Soeharto, Faith., Project Management: From Conceptual to Operational, Erlangga, 1997. 3. Journals and case study reports		

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Capita Selecta-2**
	Course Code	**CF234548**
	Credit (SKS)	**2 (Two)**
	Semester	**5 (Five)**
COURSE DESCRIPTION		
This course studies proposal writing techniques and strategies forStudent Creativity Program (PKM) and understanding the stages and areas funded in the Student Creativity Program (PKM). The course applies case method-project based learning.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-3	Able to manage one's own learning, and develop oneself as a lifelong learner to compete at national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to sustainability principles and understanding technology-based entrepreneurship.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to understand the stages of the Student Creativity Program (PKM), PKM fields, and PKM leagues.	
CLO-2	Able to master the techniques and strategies for preparing proposals for the Student Creativity Program (PKM).	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C4, P3, A3] Able to understand the Student Creativity Program (PKM), PKM stages, and PKM leagues.	
Sub CLO-2	[C4, P3, A3] Able to understand the areas funded in the Student Creativity Program (PKM).	
Sub CLO-3	[C4, P3, A3] Able to master the concepts and techniques of writing proposals for the Student Creativity Program (PKM).	
Sub CLO-4	[C4, P3, A3] Able to master the strategy for preparing PKM proposals according to the chosen field.	
STUDY MATERIALS		
• Student Creativity Program (PKM) • PKM League • PKM fields • PKM proposal writing • Strategy for preparing PKM proposals		
REQUIREMENTS		
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REFERENCES		
1. Guide to preparing PKM (Student Creativity Program) 2. ITS and Kemendikbudristek websites		

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Coal and Mineral Exploration**
	Course Code	**CF234549**
	Credit	**2 (Two)**
	Semester	**5 (Five)**
COURSE DESCRIPTION		
This course studies geological processes related to the presence of mineral and coal deposits, geophysical exploration methods that are in accordance with exploration targets, calculation of reserves and case studies of mineral and coal deposits.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data procedurally starting from identifying, formulating, analyzing and finding the source of the problem, proposing the best solution to solve the problem, designing and operationalizing the process, processing systems and hardware and software equipment required in existing geophysical engineering designs, local and national resources as well as engineering design and analysis tools that are most appropriate, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account factors law, economics, environment, socio-cultural, political, health, public safety, culture,and sustainable development.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to explain geological processes as an important factor in the formation of mineral and coal deposits	
CLO-2	Able to interpret and draw appropriate conclusions in mineral and coal exploration	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	Able to explain geological processes related to the formation of mineral deposits	
Sub CLO-2	Be able to explain the geological processes related to the formation of coal	
Sub CLO-3	Able to interpret mineral and coal exploration case studies	
Sub CLO-4	Able to make scientific reports on mineral and coal exploration	

STUDY MATERIALS

- Geological Theory of Plate Tectonics & Mineralization Process
- Mafic Layered Intrusions -Copper/Nickel Massive Sulfide
- Mafic Layered Intrusions -Chromite and Platinum PGE Deposits
- Geological Formation of Diamonds
- Porphyry Deposit Geology
- IOCG Iron Oxide Copper Gold Ore Deposits
- Mesothermal and Greenstone Gold Deposits
- Epithermal Deposits
- VMS Volcanogenic Massive Sulphide Ore Deposits
- Residual and Secondary Enrichment Deposits
- Placer deposits
- Coal Formation
- Coal Depositional Environment
- Coalification Process
- Coal Geochemist
- Coal Bearing Sequence
- Exploration concept
- Geophysical exploration
- Backup calculation

REQUIREMENTS

Geoelectric Exploration, Seismic Exploration, EGBM Exploration, EM Exploration

REFERENCES

1. Ridley, J., 2013, Ore Deposit Geology, Colorado State University, Cambridge University Press.
2. Richard, E., 1986, Ore deposit geology and its influence on mineral exploration, Chapman and Hall.
3. Dentith M., Mudge ST, 2014, Geophysics for the Mineral Exploration Geoscientist, CUP.
4. Charles J. Moon, Michael KG Whateley, Anthony M. Evans, 2006, Introduction to Mineral Exploration, Blackwell Publishing
5. Isabel Suarez-Ruiz and John C. Crelling, 2008, Applied Coal Petrology: The Role of Petrology in Coal Utilization
6. Larry J. Thomas and Larry P. Thomas, 2005, Coal Geology
7. Stephen D. Killops and Vanessa J. Killops, 2005, Introduction to Organic Geochemistry 2nd
8. Franco Pirajno, 2009, Hydrothermal Processes and Mineral Systems
9. Anthony M. Evans, 1993, Ore Geology and Industrial Minerals An Introduction 3rd
10. Richard Edwards and Keith Atkinson, 1986, Ore Deposit Geology
11. Related journals

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Geotourism**
	Course Code	**CF234550**
	Credit	**2 (Two)**
	Semester	**5 (Five)**
COURSE DESCRIPTION		
problems and aspects of geological potential that can be applied for geotourism purposes and implementing them for personal purposes or involving the environment, including for commercial entrepreneurial purposes.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-4	Able to explain the principles of mathematics, natural science, geology, geospatial, instrumentation, information technology, engineering principles and design into geophysical engineering procedures, processes, systems or methodologies.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	able to applythe principles of mathematics, natural sciences, information technology and engineering principles into the procedures and processes of developing geotourism	
CLO-2	Able to implement geological science for the development of geotourism	
CLO-3	Able to solve geophysical engineering problems in depth to optimize the use of geotourism and reduce disaster risk	
CLO-4	Able to be responsible for the results of own and group work through reports	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C4, P4, A4] Able to explain the process of forming natural landscapes (geomophology) which have the potential to develop geotourism,	
Sub CLO-2	[C4,P4,A4] Able to explain geotourism areas and/or risk of geological disaster	
Sub CLO-3	[C4, P4, A4] Able to create a Business Continuity Plan for geotourism areas that are at risk of disaster	
Sub CLO-4	[C4, P4, A4] Able to explain the implementation of geophysical engineering problems in the earth field and present them in scientific writing and communication	
STUDY MATERIALS		
1. Geotourism and Geopark 2. Disaster mitigation 3. Business Continuity Plan		
REQUIREMENTS		
Physical Geology and Structural Geology		
REFERENCES		
1. Hamblin, WK, 1982; The Earth's Dynamic Systems; 3rd Edition. Minesotta. 2. https://www.bnpb.go.id/home/get_publikasi/12/buku 3. https://www.bnpb.go.id/home/get_publikasi/13/jurnal		

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Geological Disaster Mitigation**
	Course Code	**CF234621**
	Credit	**2 (Two)**
	Semester	**6 (Six)**
COURSE DESCRIPTION		
Disaster management (UU 24 2007), threats, vulnerabilities and risks. Disaster Risk Reduction (multihazard) and risk mapping, Mitigation of earthquake disasters, tsunami disasters, liquefaction disasters, mudflow disasters and volcanic eruption disasters. Mitigation of landslides and flash floods, erosion and sedimentation disasters, flood disasters, mitigation of tornadoes.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data procedurally starting from identifying, formulating, analyzing and finding the source of the problem, proposing the best solution to solve the problem, designing and operationalizing the process, processing systems and hardware and software equipment required in existing geophysical engineering designs, local and national resources as well as engineering design and analysis tools that are most appropriate, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account factors law, economics, environment, socio-cultural, political, health, public safety, culture,and sustainable development.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to apply natural science in disaster management	
CLO-2	Able to implement geology in geological disaster risk mapping	
CLO-3	Able to solve geophysical engineering problems in depth for geological disaster mitigation	
CLO-4	Able to be responsible for the results of one's own and group work through scientific reports and presentations.	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C4,P4,A4] Be able to explain disaster mitigation,	
Sub CLO-2	[C4,P4,A4] Be able to map geological disaster risk areas	
Sub CLO-3	[C4,P4,A4] Able to analyze risk maps and disaster mitigation efforts	
Sub CLO-4	[C4, P4, A4] Able to explain the implementation of geophysical engineering problems in the earth field and present them in scientific writing and communication	

STUDY MATERIALS
1. Disaster Management 2. Risk Assessment 3. Geological Disaster Mitigation.
REQUIREMENTS
Physical Geology, Structural Geology
REFERENCES
1. Hamblin, WK, 1982; The Earth's Dynamic Systems; 3rd Edition. Minesotta. 2. http://www.tulane.edu/~sanelson/Natural_Disasters/ 3. http://nidm.gov.in/PDF/modules/geo.pdf 4. ftp://ftp.itc.nl/pub/westen/Multi_hazard_risk_course/Powerpoints/Background%20paper%20Spatial%20data%20for%20hazard%20and%20risk%20assessment.pdf 5. Journal of Geology 6. https://www.bnpb.go.id/home/get_publikasi/12/buku 7. https://www.bnpb.go.id/home/get_publikasi/13/jurnal

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Seismic Data Processing And Acquisition**
	Course Code	**CF234637**
	Credit	**2 (Two)**
	Semester	**6 (Six)**
COURSE DESCRIPTION		
This course deepens mastery of seismic data acquisition and processing in 2 dimensions and 3 dimensions for various specific earth problems. The course applies case method-project based learning.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply procedural processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data starting from identifying, formulating, analyzing and finding the source of problems, proposing the best solutions to solve problems, designing and operationalizing processes, processing systems and hardware and software equipment needed in existing geophysical engineering designs, local, national resources and engineering design and analysis tools that are most suitable, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account factors law, economics, environment, socio-cultural, political, health, public safety, culture,and sustainable development.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to explain the concept of seismic data acquisition and make 2-dimensional and 3-dimensional seismic acquisition designs for land and sea surveys.	
CLO-2	Able to carry out seismic data processing (basic seismic processing) based on information and computing technology to solve geophysical engineering problems	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C4, P3, A3] Able to explain the concept of 2-dimensional and 3-dimensional seismic data acquisition for surveys on land and at sea.	
Sub CLO-2	[C4,P3,A3] Be able to make 2D and 3D seismic acquisition designs to solve geophysical engineering problems.	

Sub CLO-3	[C4,P3,A3] Able to analyze seismic data signals and events on seismic data.
Sub CLO-4	[C4, P3, A3] Able to carry out seismic data processing (basic seismic processing) based on information and computing technology to solve geophysical engineering problems.

STUDY MATERIALS

- Review of exploration seismic methods
- 2D seismic acquisition design
- 3-dimensional seismic design
- Land and sea seismic acquisitions
- Acquisition seismic geometry
- Seismic data signal analysis
- Seismic data pre-processing
- Speed analysis
- Seismic data migration
- Latest data acquisition and processing technology

REQUIREMENTS

Seismic Exploration

REFERENCES

1. Vermeer, G.J.O., “Fundamentals of 3-D seismic survey design.”, 2001
2. Costain, JK and Çoruh, C.,"Basic theory of exploration seismology.", Elsevier, 2004.
3. Chapman, CH, "Fundamentals of seismic wave propagation.", Cambridge University Press, 2004.
4. Shearer, PM ,"Introduction to Seismology.", Cambridge University Press, 2009
5. Geophysical Journal

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Reservoir Geophysics**
	Course Code	**CF234638**
	Credit	**3 (Three)**
	Semester	**6 (Six)**
COURSE DESCRIPTION		
Students understand the basic properties of reservoirs related to geological events and the presence of economic fluids. Students are able to perform stratigraphic seismic analysis in interpreting seismic data Students are able to integrate all reservoir data for modeling		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply procedural processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data starting from identifying, formulating, analyzing and finding the source of problems, proposing the best solutions to solve problems, designing and operationalizing processes, processing systems and hardware and software equipment required in existing geophysical engineering designs, local, national resources and engineering design and analysis tools that are most appropriate, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account legal, economic, environmental, socio-cultural, political, health factors , public safety, culture and sustainable development.	
COURSE LEARNING OUTCOMES (CLO)		
CLO	Able to explain the basic concept of reservoir property and seismic stratigraphy including inversion method in seismic, applying geostatistics and doing reservoir modeling.	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C4, P3, A3] Able to explain the basic concepts of Reservoir Property	
Sub CLO-2	[C4,P3,A3] Be able to explain the concepts of Seismic Stratigraphy and Seismic Inversion	
Sub CLO-3	[C4,P3,A3] Be able to explain the concept of Geostatistics	
Sub CLO-4	[C4,P3,A3] Able to perform reservoir modeling (V-Shale, Porosity, Water Saturation) and Volumetric Calculations (Monte Carlo)	
STUDY MATERIALS		
Reservoir Properties Sedimentation and Stratigraphy		

Depositional Environment and Facies
Seismic Stratigraphy
Seismic Inversion
Pre-Stack and Post-Stack
AVO analysis
Kriging and Co-Kriging
Gaussian Model

REQUIREMENTS

Seismic Exploration, Well-Log Data Analysis

REFERENCES

1. Dubrule, O., 2003, Geostatistics for Seismic Data Integration in Earth Model, SEG & EAGE
2. PYRCZ, MJ, DEUTSCH, CV, 2014, GEOSTATISTICAL RESERVOIR MODELING, Oxford University Press, New York
3. Darling, T., “Well Logging and Formation Evaluation”, Elsevier Inc., 2005. Zobin, VM, 2012, Introduction to Volcanic Seismology, Elsevier, London, UK
4. Tiab, D. and Donaldson, EC, “Petrophysics 2nd.”, Elsevier, 2004.
5. Asquith, GB And Krygowski, D., "Basic Well Log Analysis, 2nd", American Association of Petroleoum Geologists, 2004.
6. Brown, A., "Interpretation of Three-Dimensional Seismic Data", American Association of Petroleoum Geologists, 2004.
7. Sheriff, RE, Exploration Seismology, Cambridge Univ. Press. 1995.
8. Avseth, P., Mukerji, T., and Mavko, G., “Quantitative Seismic Interpretation”, Cambridge University Press., 2005. Thorne Lay, Terry C. Wallace-Modern Global Seismology, Vol. 58-Academic Press (1995).
9. AAPG and IPA Journals and Proceedings

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Passive Electromagnetic Exploration**
	Course Code	**CF234639**
	Credit	**3 (Three)**
	Semester	**6 (Six)**
COURSE DESCRIPTION		
Basic concepts of electromagnetic fields (MT, VLF), basic principles of the Law of Electromagnetic Induction, Maxwell, magnetic transfers, electric transfers, far field, near field. The role of electromagnetic methods in the exploration of minerals, oil and gas and earth resources; source and recipient type; Get to know low frequency EM methods: magnetotelluric (MT), radio magnetotelluric (RMT), Very Low Frequency (VLF), Transient Electromagnetics (TEM), EM induction; Low frequency EM practicum (VLF, TEM), and examples of EM applications in geotechnical, mining, hydrogeological studies, earth crust studies, oil and gas and geothermal exploration		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain concepts, principles of geophysical methodology to create or modify models in solving complex geophysical engineering problems in depth and procedurally by prioritizing concepts and principles of environmental preservation, occupational safety and health in laboratories and fields, principles and current issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply processes or components of geophysical engineering methods procedurally starting from identifying, formulating, analyzing and finding the source of problems, proposing the best solutions to solve problems, designing and operationalizing processes, processing systems and equipment required in existing geophysical engineering designs, utilizing resources local, national resources as well as the most appropriate, effective and efficient engineering design and analysis tools in solving geophysical engineering problems in depth by taking into account legal, economic, environmental, socio-cultural, political, health, public safety, culture and sustainable development factors. development).	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to master the concepts and principles of mathematics and natural science for the Electromagnetic Method (VLF and MT)	
CLO-2	Able to implement the Electromagnetic Method procedurally starting from data search, processing, subsurface geology and modeling to solve deep problems	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C4, P4, A4] Able to explain the basic concepts and principles of Electromagnetic Waves and their relationship with the physical characteristics of rocks	
Sub CLO-2	[C4,P4,A4] Be able to explain the concept of Maxwell's law	

Sub CLO-3	[C4,P4,A4] Able to explain concepts, perform processing and interpretation of low frequency EM data: Very Low Frequency and Magnetotelluric
Sub CLO-4	[C4,P4,A4] Able to explain the implementation of geophysical engineering problems in the earth field and present it in scientific writing and communication

STUDY MATERIALS

1. **Basic concepts of electromagnetic waves**: wave properties, physical and mathematical principles for electric and magnetic fields.
2. **Electromagnetic exploration management**procedurally: Concept, survey design with 1D-2D, data processing and interpretation.
3. **Application of EM methods in the earth field:**Writing scientific reports with integration of EM method data and geological conditions, standard maps and geophysical cross sections.

REQUIREMENTS

Mathematical Geophysics, Structural Geology

REFERENCES

1.Telford, W., Geldart, LP, Sheriff, RE (1976). Applied Geophysics. Cambridge Univ Press, Cambridge.
2. Zhdanov, M.S. (2009). Geophysical Electromagnetic Theory and Methods. Elsevier.
3. Simpson, F. and Bahr, K. (2005). Practical Magnetotelluric. Cambridge.
4. Griffiths, DJ (1999). Introduction to Electrodynamics, 3rd ed., Prentice Hall.
5. Journal of Geophysics

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
Course	**Course Name**	**Hydrogeology**
	Course Code	**CF234651**
	Credit	**2 (Two)**
	Semester	**6 (Six)**

COURSE DESCRIPTION

In this course, the basics of hydrogeology will be explained, including groundwater geology, groundwater hydrology, well and aquifer hydraulics, groundwater quality, eye hydrogeology. water, groundwater investigation methods, filling techniques and well construction planning, groundwater pollution and sanitation techniques, seawater intrusion and control, groundwater recharge methods and evaluating groundwater potential, identifying the presence of groundwater using geophysical methods and analyzing and exploring the existence of groundwater based on geological settings .

PROGRAM LEARNING OUTCOMES (PLO)

PLO-4	Able to explain the principles of mathematics, natural science, geology, information technology and engineering principles into geophysical engineering procedures, processes, systems or methodologies..

COURSE LEARNING OUTCOMES (CLO)

CLO-1	Able to explain the concept of groundwater formation and availability
CLO-2	Able to apply hydrogeological concepts in identifying groundwater problems and solving solutions

SUB COURSE LEARNING OUTCOMES (SUB CLO)

Sub CLO-1	[C2,A3] Be able to explain the concept of groundwater formation
Sub CLO-2	[C2,A3] Able to apply the concept of aquifer systems to every geological setting
Sub CLO-3	[C3,A3] Able to apply hydrogeological concepts to groundwater modeling
Sub CLO-4	[C3,A3] Able to apply hydrogeological concepts to evaluate aquifer systems and groundwater problems

STUDY MATERIALS

- Introduction to groundwater
- Availability of ground water
- Groundwater basin
- Groundwater recharge and discharge areas
- Groundwater dynamics
- Groundwater chemistry and groundwater quality
- Groundwater pollution
- Hydrogeological map
- Groundwater investigation
- Groundwater balance
- Groundwater modeling

PRECONDITION

Physical Geology, Petrology, Geological Structure, Geoelectricity

REFERENCES

1. Todd DK, Mays LW, 2005, Groundwater Hydrogeology ed. 3rd, John Willey and Sons, New York, 537 p.
2. Fetter CW, 2001, Applied Hydrogeology ed. 4th, Prentice Hall, New Jersey, 598 p.

3. Freeze RA, and Cherry JA, 1979, Groundwater, Prentice Hall, New Jersey, 604 p.
4. Danaryanto RJ, Kodoatie, Hadiparwo S., and Sangkawati S., 2008, Groundwater Management Based on Groundwater Basins, Department of Energy and Mineral Resources, Jakarta, 345 p.
5. Mazor E., 1997, Chemical and Isotopic Groundwater Hydrology, The Applied Approach ed. 2nd, Marcel Dekker Inc., New York, 409 p.
6. Singhal BBS, and Gupta RP, 2010, Applied Hydrogeology of Fractured Rock ed. 2nd, Springer, New York, 408 p.
7. Domenico AP, and Sxhartz FW, 1990, Physical and Chemical Hydrogeology, John Willey and Sons, New York, 824 p.
8. Journals and publications

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
Course	**Course Name**	**Integrated Field Lecture 1**
	Course Code	**CF234652**
	Credit (SKS)	**4 (Four)**
	Semester	**6 (Six)**
COURSE DESCRIPTION		
This course is a preparation for implementing the capstone to gain field experience in the implementation and management of geophysical exploration and geological exploration obtained from studying previous courses starting from planning, data acquisition, processing and interpretation of geological-geophysical data to a basic understanding of concepts. / basic principles of exploration and techniques that are effective and efficient in achieving exploration time and targets. Activities are carried out in group work (Collaboration/Group Based Project) for an earth problem (Problem Based Learning) so that students can think critically and practice responsibility for group and individual work to achieve common goals.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply procedural processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data starting from identifying, formulating, analyzing and finding the source of problems, proposing the best solutions to solve problems, designing and operationalizing processes, processing systems and hardware and software equipment needed in existing geophysical engineering designs, local, national resources and engineering design and analysis tools that are most suitable, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account factors law, economics, environment, socio-cultural, political, health, public safety, culture,and sustainable development.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to implement Geological Exploration Methods procedurally starting from basic concepts, data collection/acquisition, data processing, and modeling to solve earth problems in depth.	
CLO-2	Able to implement Geophysical Exploration Methods procedurally starting from basic concepts, data collection/acquisition, data processing, and modeling to solve earth problems in depth.	
CLO-3	Able to analyze and organize data starting from planning, collecting, processing data and interpreting the results logically, systematically, independently and responsibly.	

SUB COURSE LEARNING OUTCOMES (SUB CLO)	
Sub CLO-1	[C4,P3,A3] Able to implement Geological Exploration Methods procedurally starting from basic concepts, data retrieval/acquisition, data processing, and modeling to solve earth problems in depth.
Sub CLO-2	[C4,P3,A3] Able to implement Geophysical-Geoelectrical Exploration Methods procedurally starting from basic concepts, data retrieval/acquisition, data processing, and modeling to solve earth problems in depth.
Sub CLO-3	[C4,P3,A3] Able to implement Geophysical-Seismic Exploration Methods procedurally starting from basic concepts, data retrieval/acquisition, data processing, and modeling to solve earth problems in depth.
Sub CLO-4	[C4,P3,A3] Able to implement Geophysical-Electromagnetic Exploration Methods procedurally starting from basic concepts, data retrieval/acquisition, data processing, and modeling to solve earth problems in depth.
Sub CLO-5	[C4,P3,A3] Able to implement Geophysical Exploration Methods - Gravity and Magnetics procedurally starting from basic concepts, data retrieval/acquisition, data processing, and modeling to solve earth problems in depth.
Sub CLO-6	[C4, P3, A3] Able to analyze and organize data starting from planning, collecting, processing data and interpreting the results logically, systematically, independently and responsibly in the form of scientific reports and presentations effectively.

STUDY MATERIALS

- Surface geological observations
- Geological mapping
- Survey design, processing, and interpretation/analysis of geophysical exploration methods: Seismic Method, Gravity and Magnetic Method, Geoelectric Method, Electromagnetic Method

PRECONDITION

Seismic Exploration, Geoelectric Exploration, Electromagnetic Exploration, Gravity and Magnetic Exploration, Inversion Method, Structural Geology

REFERENCES

1. Telford et al., Applied Geophysics, Cambridge Univ. Press, 1976
2. Reynolds, J.M., An Introduction to applied and environmental Geophysics. John Wiley and Sons, 1997.
3. Sheriff, RE, and LP Geldart, Exploration Seismology. Cambridge Univ. Press, 1995.
4. Grant & West, Interpretation Theory in Applied Geophysics, Mc. Graw-Hill Book Company, 1965.3.
5. Billings, MP, 1982, Structural Geology, Prentice Hall, New Delhi.
6. Indexed international and national journals.

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
Course	**Course Name**	**Seminar**
	Course Code	**CF234722**
	Credit (SKS)	**2 (Two)**
	Semester	**7 (Seven)**
COURSE DESCRIPTION		
This course is an introduction to research methodology for scientific activities, being able to master the basics of making scientific reports and publications using information technology, mastering the basic techniques of scientific presentations, a series of pre-preparation final assignments starting from title selection, literature search, paper writing, paper presentation, defending and responsible for the paper in the final assignment session		
PORGRAM LEARNING OUTCOMES (PLO)		
PLO-2	Able to study and utilize science and technology in order to apply it to the field of geophysical engineering, and able to make appropriate decisions from the results of one's own work or group work in the form of a final assignment report or other form of learning activity whose output is equivalent to the final assignment through logical, critical thinking , systematic and innovative.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	[C3,P3,A3] Studentsmaster information technology and effective communication techniques verbally and in writing based on scientific rules, procedures and ethics for specific purposes in general and geophysical engineering activities in particular.	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C3.P3,A3] Students are able to understand the rules, procedures for scientific thinking, apply research methodology to study final assignment topics and other scientific activities in general and procedurally using information technology.	
Sub CLO-2	[C3.P3,A3] Students masterconcepts and techniques for geological research methods orally and in writing for general specific purposes and geophysical engineering activities.	
Sub CLO-3	[C3.P3,A3] Students masterconcepts and techniques for researching geophysical methods orally and in writing for general specific purposes and geophysical engineering activities.	
Sub CLO-4	[C3.P3,A3] Students mastergeneral concepts, principles, and communication techniques in oral form and scientific papers using appropriate information technology for general specific purposes and geophysical engineering activities.	
STUDY MATERIALS		
Scientific writing techniques, references, geophysical communications, scientific presentations, publications (posters, journals, proceedings)		
PRECONDITION		
Seismic Exploration, Geoelectric Exploration, Electromagnetic Exploration, Gravity and Magnetic Exploration, Inversion Method, Structural Geology		
REFERENCES		
1. Briscoe, MH, A guide to scientific illustrations 2. Cargill, M. and O'Connor, P., Writing Scientific Research Article 3. ITS Final Project Guidelines and Geophysical Engineering Department-FTSPK 4. Earth Journal		

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER **FACULTY OF CIVIL PLANNING AND GEO ENGINEERING** **GEOPHYSICAL ENGINEERING DEPARTMENT** **UNDERGRADUATE PROGRAM (S1)**	
Course	**Course Name**	**Integrated Field Lecture-2**
	Course Code	**CF234723**
	Credit (SKS)	**4 (Four)**
	Semester	**7 (Seven)**
COURSE DESCRIPTION		
This course is a capstone where students gain field experience in the implementation and management of geophysical exploration and geological exploration obtained from studying previous courses starting from planning, data acquisition, processing and interpretation of geological-geophysical data to a basic understanding of concepts/ basic principles of exploration and techniques that are effective and efficient in achieving exploration time and targets. Activities are carried out in group work (Collaboration/Group Based Project) for an earth problem (Problem Based Learning) so that students can think critically and practice responsibility for group and individual work to achieve common goals.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data procedurally starting from identifying, formulating, analyzing and finding the source of the problem, proposing the best solution to solve the problem, designing and operationalizing the process, processing systems and hardware and software equipment required in existing geophysical engineering designs, local and national resources as well as engineering design and analysis tools that are most appropriate, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account factors law, economics, environment, socio-cultural, political, health, public safety, culture,and sustainable development.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Students are able to implement Geological Exploration Methods procedurally starting from basic concepts, data collection/acquisition, data processing, and modeling to solve earth problems in depth.	
CLO-2	Students are able to implement Geophysical Exploration Methods procedurally starting from basic concepts, data collection/acquisition, data processing, and modeling to solve earth problems in depth.	
CLO-3	Students are able to analyze and organize data starting from planning, collecting, processing data and interpreting the results logically, systematically, independently and responsibly.	

SUB COURSE LEARNING OUTCOMES (SUB CLO)	
Sub CLO-1	[C4, P3, A3] Students are able to implement Geological Exploration Methods procedurally starting from basic concepts, data retrieval/acquisition, data processing, and modeling to solve earth problems in depth.
Sub CLO-2	[C4, P3, A3] Students are able to implement Geophysical-Geoelectric Exploration Methods procedurally starting from basic concepts, data retrieval/acquisition, data processing, and modeling to solve earth problems in depth.
Sub CLO-3	[C4, P3, A3] Students are able to implement Geophysical-Seismic Exploration Methods procedurally starting from basic concepts, data retrieval/acquisition, data processing, and modeling to solve earth problems in depth.
Sub CLO-4	[C4, P3, A3] Students are able to implement Geophysical-Electromagnetic Exploration Methods procedurally starting from basic concepts, data retrieval/acquisition, data processing, and modeling to solve earth problems in depth.
Sub CLO-5	[C4, P3, A3] Students are able to implement Geophysical Exploration Methods - Gravity and Magnetics procedurally starting from basic concepts, data collection/acquisition, data processing, and modeling to solve earth problems in depth.
Sub CLO-6	[C4, P3, A3] Students are able to analyze and organize data starting from planning, collecting, processing data and interpreting the results logically, systematically, independently and responsibly in the form of scientific reports and presentations effectively.

STUDY MATERIALS

- Surface geological observations
- Geological mapping
- Survey design, processing, and interpretation/analysis of geophysical exploration methods: Seismic Method, Gravity and Magnetic Method, Geoelectric Method, Electromagnetic Method

PRECONDITION

Seismic Exploration, Geoelectric Exploration, Electromagnetic Exploration, Gravity and Magnetic Exploration, Inversion Method, Structural Geology

REFERENCES

1. Telford et al., Applied Geophysics, Cambridge Univ. Press, 1976
2. Reynolds, J.M., An Introduction to applied and environmental Geophysics. John Wiley and Sons, 1997.
3. Sheriff, RE, and LP Geldart, Exploration Seismology. Cambridge Univ. Press, 1995.
4. Grant & West, Interpretation Theory in Applied Geophysics, Mc. Graw-Hill Book Company, 1965.3.
5. Billings, MP, 1982, Structural Geology, Prentice Hall, New Delhi.
6. Indexed international and national journals.

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Geothermal Exploration**
	Course Code	**CF234740**
	Credit	**3 (Three)**
	Semester	**7 (Seven)**
COURSE DESCRIPTION		
Students understand the rules of geothermal exploration within the framework of a total geothermal potential development project, both in technical, economic and legal aspects. This course aims to understand the geothermal conceptual model through processing geophysical, geological and geochemical data and a physical model approach based on the rules for increasing geothermal gradients due to volcanic and non-volcanic phenomena. The conceptual model was built based on an integrative study of various geological exploration results as an initial approach, then through a geophysical methodological approach to describe the alleged prospect area which will be strengthened by geochemical measurement evidence of geothermal phenomena on the earth's surface.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain concepts, principles of geophysical methodology to create or modify models in solving complex geophysical engineering problems in depth and procedurally by prioritizing concepts and principles of environmental preservation, occupational safety and health in laboratories and fields, principles and current issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply processes or components of geophysical engineering methods procedurally starting from identifying, formulating, analyzing and finding the source of problems, proposing the best solutions to solve problems, designing and operationalizing processes, processing systems and equipment required in existing geophysical engineering designs, utilizing resources local, national resources as well as the most appropriate, effective and efficient engineering design and analysis tools in solving geophysical engineering problems in depth by taking into account legal, economic, environmental, socio-cultural, political, health, public safety, culture and sustainable development factors. development).	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	C4, P3, A3] Able to organize secondary data from geothermal exploration studies and present it again according to the needs or objectives of the activity as well as evaluate the operational procedures of the geophysical engineering technology carried out	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C4,P3,A3] Be able to explain the concepts and stages of Geothermal Exploration	
Sub CLO-2	[C4,P3,A3] Be able to understand the relationship between geothermal energy and geological conditions and be able to explain geothermal fields in Indonesia.	

Sub CLO-3	[C4,P3,A3] Be able to analyze a geophysical case study in geothermal exploration
Sub CLO-4	[C4,P3,A3] Able to create simple conceptual models of geothermal reservoirs that are integrated with geoscience studies and present them in scientific writing and communication
STUDY MATERIALS	
Basic concepts of geothermal systems, Procedural management of geothermal exploration: geological, geophysical and geochemical studies and supporting studies (social, cultural, legal, environmental, sustainable), Making conceptual models, calculating reserves, Introduction to geothermal exploitation	
REQUIREMENTS	
Structural Geology Gravity and Magnetic Exploration Electromagnetic Exploration	
REFERENCES	
1.Telford, W., Geldart, LP, Sheriff, RE (1976). Applied Geophysics. Cambridge Univ Press, Cambridge. 2. Zhdanov, M.S. (2009). Geophysical Electromagnetic Theory and Methods. Elsevier. 3. Handbook of Geothermal Energy, Editors: Edwards, LM, Chilingar, GV et al. , Gulf Publishing Company, 1982, 613 pp. 4.Goff, F., Janik, CJ (2000), Geothermal Systems, Editors: Haraldur Sigurdsson, Encyclopedia of Volcanoes, Academic Press, pp. 817-8344. 5. National and international Geophysics Journals - indexed	

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER **FACULTY OF CIVIL PLANNING AND GEO ENGINEERING** **GEOPHYSICAL ENGINEERING DEPARTMENT** **UNDERGRADUATE PROGRAM STUDY**	
Course	**Course Name**	**Geotomography**
	Course Code	**CF234741**
	Credit	**3 (Three)**
	Semester	**6 (Six)**
COURSE DESCRIPTION		
This course studies the concept of seismic cross-hole tomography in imaging the earth's subsurface using seismic waves and its application to the earth globally and in geophysical exploration activities.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply procedural processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data starting from identifying, formulating, analyzing and finding the source of problems, proposing the best solutions to solve problems, designing and operationalizing processes, processing systems and hardware and software equipment needed in existing geophysical engineering designs, local, national resources and engineering design and analysis tools that are most suitable, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account factors law, economics, environment, socio-cultural, political, health, public safety, culture,and sustainable development.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to design a seismic cross-hole model based on geotomography concepts by taking into account geological rules and exploration objectives.	
CLO-2	Able to apply a seismic cross-hole model based on the concept of geotomography with due regard to geological principles and exploration objectives.	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C4,P3,A4] Able to design matrix inversion method, Back Projection Technique -BPT, Algebraic reconstruction technique - ART and Simultaneous Iterative reconstruction technique- SIRT on seismic cross-hole tomography	
Sub CLO-2	[C4,P3,A4] Able to design Algebraic reconstruction technique methods - ART and Simultaneous Iterative reconstruction technique- SIRT on anisotropy seismic cross-hole tomography	
Sub CLO-3	[C4,P3,A4] Able to apply the Algebraic reconstruction technique - ART and Simultaneous Iterative reconstruction technique- SIRT methods on seismic cross-hole tomography	

Sub CLO-4	[C4,P3,A4] Able to apply the Algebraic reconstruction technique - ART and Simultaneous Iterative reconstruction technique- SIRT methods on anisotropy seismic cross-hole tomography

STUDY MATERIALS

- Basic concepts of seismic cross hole tomography
- Matrix inversion technique method, Back Projection Technique -BPT, Algebraic reconstruction technique - ART and Simultaneous Iterative reconstruction technique- SIRT for isotropic medium
- Seismic cross hole in an anisotropic medium
- Algebraic reconstruction technique inversion technique - ART and Simultaneous Iterative reconstruction technique- SIRT for anisotropic medium

REQUIREMENTS

Seismic Exploration

REFERENCES

1. Wang, Y. “Seismic Amplitude Inversion in Reflection Tomography”, Elsevier science, 2003.
2. Iyer HM and Hirahara, K. (Ed.), 1993. Seismic Tomography: Theory and Practice. Chapman & Hall, London.
3. Leon Thomsen, 2002. Understanding Seismic Anisotropy in Exploration and Exploitation
4. Nolet, G. (Ed.), 1987. Seismic Tomography with applications in global seismology and exploration geophysics. D. Reidel Publishing Company, Dordrecht.
5. Geophysics Journal

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Geothermal Engineering**
	Course Code	**CF234742**
	Credit	**3 (Three)**
	Semester	**7 (Seven)**
COURSE DESCRIPTION		
Hot steam from within the earth must be channeled into the turbine room to drive the electricity generation system turbine and then out to be injected back into the earth's surface. Physical (major) and chemical (minor) changes are the main study material in this course. Water vapor from the reservoir can be in single or double phase throughout its journey. drilling techniques, reservoir techniques, well testing, steam production facilities, production techniques, geothermal utilization for electricity generation, direct utilization or utilization for the non-electricity sector, and legal aspects.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data procedurally starting from identifying, formulating, analyzing and finding the source of the problem, proposing the best solution to solve the problem, designing and operationalizing the process, processing systems and hardware and software equipment required in existing geophysical engineering designs, local and national resources as well as engineering design and analysis tools that are most appropriate, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account factors law, economics, environment, socio-cultural, political, health, public safety, culture,and sustainable development.	
COURSE LEARNING OUTCOMES (CLO)		
CLO	[C3,P3,A3] Able to understand geothermal exploitation, from well drilling to electricity generation and direct utilization	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C3, P3, A3] Be able to explain the concept of geothermal exploitation and its application.	
Sub CLO-2	[C3,P3,A3] Able to review geothermal field development plans and conduct tests to optimize geothermal exploitation.	
Sub CLO-3	[C3,P3,A3] Able to apply reservoir and well performance modeling simulations for field development.	

Sub CLO-4	[C3,P3,A3] Able to review regulations related to geothermal exploitation.
STUDY MATERIALS	
• Geology • Geophysics • Geochemistry	
REQUIREMENTS	
Geothermal Exploration	
REFERENCES	
1. Nenny Miryani Saptadji (2001): Geothermal Engineering, Petroleum Engineering Study Program's Diktat. 2. D'Sullivan MJ & McKibbin R. (1989) : Geothermal Reservoir Engineering, a Manual for Geothermal Reservoir Engineering Course at the Geothermal Institute – University of Auckland. 3. National and international Geophysical Journals - indexed	

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
Course	**Course Name**	**Groundwater Exploration**
	Course Code	**CF234753**
	Credit (SKS)	**2 (Two)**
	Semester	**7 (Seven)**
COURSE DESCRIPTION		
This course will explain the basics of hydrogeology including groundwater geology, groundwater hydrology, well and aquifer hydraulics, groundwater quality, eye hydrogeology. water, groundwater investigation methods, filling techniques and well construction planning, groundwater pollution and sanitation techniques, seawater intrusion and control, groundwater recharge methods and evaluating groundwater potential, identifying the presence of groundwater using geophysical methods and analyzing and exploring the existence of groundwater based on geological settings . The course applies the case learning method.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data procedurally starting from identifying, formulating, analyzing and finding the source of the problem, proposing the best solution to solve the problem, designing and operationalizing the process, processing systems and hardware and software equipment required in existing geophysical engineering designs, local and national resources as well as engineering design and analysis tools that are most appropriate, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account factors law, economics, environment, socio-cultural, political, health, public safety, culture,and sustainable development.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to explain the concept of groundwater formation and availability	
CLO-2	Able to apply geophysical methods to identify groundwater availability	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C2,A3] Be able to explain the concept of groundwater formation	
Sub CLO-2	[C2,A3] Able to apply the concept of aquifer systems to every geological setting	
Sub CLO-3	[C3,A3] Able to apply geophysical methods to analyze the presence of groundwater	

Sub CLO-4	[C3,A3] Able to apply hydrogeological and geophysical concepts to evaluate aquifer systems and groundwater problems

STUDY MATERIALS

- Introduction to Groundwater
- Availability of ground water
- Groundwater Basin
- Groundwater Recharge and Discharge Areas
- Groundwater Dynamics
- Groundwater chemistry and groundwater quality
- Groundwater pollution
- Hydrogeological Map
- 1D and 2D geoelectricity for groundwater exploration
- 3D geoelectric data for groundwater exploration
- VLF – EM method for groundwater exploration
- Well log for groundwater exploration
- Groundwater investigation
- Groundwater exploration management

PRECONDITION

Geoelectric Exploration

REFERENCES

1. Todd DK, Mays LW, 2005, Groundwater Hydrogeology ed. 3rd, John Willey and Sons, New York, 537 p.
2. Fetter CW, 2001, Applied Hydrogeology ed. 4th, Prentice Hall, New Jersey, 598 p.
3. Freeze RA, and Cherry JA, 1979, Groundwater, Prentice Hall, New Jersey, 604 p.
4. Danaryanto RJ, Kodoatie, Hadiparwo S., and Sangkawati S., 2008, Groundwater Management Based on Groundwater Basins, Department of Energy and Mineral Resources, Jakarta, 345 p.
5. Mazor E., 1997, Chemical and Isotopic Groundwater Hydrology, The Applied Approach ed. 2nd, Marcel Dekker Inc., New York, 409 p.
6. Singhal BBS, and Gupta RP, 2010, Applied Hydrogeology of Fractured Rock ed. 2nd, Springer, New York, 408 p.
7. Domenico AP, and Sxhartz FW, 1990, Physical and Chemical Hydrogeology, John Willey and Sons, New York, 824 p.

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Disaster Geophysics**
	Course Code	**CF234754**
	Credit	**3 (Three)**
	Semester	**7 (Seven)**
COURSE DESCRIPTION		
This course studies geophysical methods that explain geological disaster phenomena such as landslides, earthquakes, tsunamis and volcanic eruptions as well as efforts to monitor and mitigate disasters. The course applies case method-project based learning.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain concepts, principles of geophysical methodology to create or modify models in solving complex geophysical engineering problems in depth and procedurally by prioritizing concepts and principles of environmental preservation, occupational safety and health in laboratories and fields, principles and current issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply processes or components of geophysical engineering methods procedurally starting from identifying, formulating, analyzing and finding the source of problems, proposing the best solutions to solve problems, designing and operationalizing processes, processing systems and equipment required in existing geophysical engineering designs, utilizing resources local, national resources as well as the most appropriate, effective and efficient engineering design and analysis tools in solving geophysical engineering problems in depth by taking into account legal, economic, environmental, socio-cultural, political, health, public safety, culture and sustainable development factors. development).	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to explain the concept of geological disaster based on its physical parameters	
CLO-2	Able to implement geophysical methods procedurally starting from data search, processing, subsurface geology and modeling to solve in-depth problems.	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C2,A3] Be able to explain concepts and earthquakes and tsunamis, as well as their relationship with the physical properties of rocks using written tests/written assessments.	
Sub CLO-2	[C2,A3] Be able to explain the concepts of landslides and volcanic eruptions and their relationship with the physical properties of rocks using a written assessment.	
Sub CLO-3	[C3, P3, A4] Able to implement seismic geophysical methods in procedural disaster mitigation and monitoring.	
Sub CLO-4	[C3,P3,A4] Able to implement procedural non-seismic geophysical methods in disaster mitigation disaster monitoring.	

STUDY MATERIALS
• Review of Geological Disasters • Earthquake Disaster • Tsunami disaster • Volcanic Eruption Disaster • Landslide Disaster • Utilization of non-seismic methods in disaster mitigation and monitoring • Utilization of seismic methods in disaster mitigation and monitoring
REQUIREMENTS
Seismology
REFERENCES
1. Shearer, PM, 2009, Introduction to Seismology, Cambridge University Press, Cambridge, UK. 2. Zobin, VM, 2012, Introduction to Volcanic Seismology, Elsevier, London, UK. 3. Jens Havskov, Gerardo Alguacil (auth.)-Instrumentation in Earthquake Seismology-Springer International Publishing (2016) 4. Barbara Romanowicz, Adam Dziewonski-Seismology and Structure of the Earth_ Treatise on Geophysics-Elsevier (2009) 5. Agustin Udías-Principles of Seismology-Cambridge University Press (2000). 6. Applied Geophysics – Seismic Method 7. Geophysical Journal

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Archaeological Geophysics**
	Course Code	**CF234755**
	Credit	**3 (Three)**
	Semester	**7 (Seven)**
COURSE DESCRIPTION		
This course studies the geoscientific approach in archeology, understanding basic archaeological concepts, Paleodisaster, Sedimentation Processes and Stratigraphy, Radiocarbon dating, application of geophysical methods that can be used to map subsurface alleged locations of archaeological sites.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain concepts, principles of geophysical methodology to create or modify models in solving complex geophysical engineering problems in depth and procedurally by prioritizing concepts and principles of environmental preservation, occupational safety and health in laboratories and fields, principles and current issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply processes or components of geophysical engineering methods procedurally starting from identifying, formulating, analyzing and finding the source of problems, proposing the best solutions to solve problems, designing and operationalizing processes, processing systems and equipment required in existing geophysical engineering designs, utilizing resources local, national resources as well as the most appropriate, effective and efficient engineering design and analysis tools in solving geophysical engineering problems in depth by taking into account legal, economic, environmental, socio-cultural, political, health, public safety, culture and sustainable development factors. development).	
COURSE LEARNING OUTCOMES (CLO)		
CLO	Able to apply geological-geophysical studies in completing archaeological case studies	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C4,P3,A3] Able to study and explain the history of archeology from a terrestrial perspective	
Sub CLO -2	[C4, P3, A3] Able to apply geological studies in solving archaeological problems	
Sub CLO-3	[C4,P3,A3] Able to apply Geodesy-Geophysics studies in solving archaeological problems	
Sub CLO-4	[C4,P3,A3] Able to analyze and model data integration in archaeological studies and present it in reports and presentations	
STUDY MATERIALS		
• Basic Concepts of Archaeology • Geoscientific Approaches to Archaeology • Paleo disaster • Sedimentation and Stratigraphic Processes • RadioCarbon Dating		

- Method – Geophysical Method
- Interpretation of Geophysical Data in Archeology
- Case study

REQUIREMENTS

- Geological disaster mitigation
- Stratigraphic Sedimentation
- Electromagnetic exploration
- Geoelectric Exploration

REFERENCES

1. Siart, C., Forbriger, M., Bubenzer, O. (Eds.), 2018. Digital Geoarchaeology: New Techniques for Interdisciplinary Human-Environmental Research, Natural Science in Archeology. Springer International Publishing. https://doi.org/10.1007/978-3-319-25316-9
2. Goldberg, P., & Macphail, R. (2006). Practical and Theoretical Geoarchaeology. Oxford: Blackwell
3. Holliday, V. T. (2004). Soils in Archaeological Research. New York, Oxford University Press. KEY REFERENCE FOR GEOARCHAEOLOGY OF SOILS
4. Stoops, G. and C. Nicosia, Eds. (2017). Archaeological Soil and Sediment Micromorphology. New York, Wiley and sons.

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**Agricultural Geophysics**
	Course Code	**CF234756**
	Credit	**2 (Two)**
	Semester	**7 (Seven)**
COURSE DESCRIPTION		
Agricultural soil physical parameters		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-5	Able to explain the concepts and principles of geophysical engineering methods that utilize geological, geospatial, instrumentation and information technology data to create or modify models to solve complex geophysical and geophysical engineering problems in depth and procedurally by prioritizing conservation concepts and principles environment, occupational safety and health in the laboratory and field, current principles and issues in legal, economic, environmental, socio-cultural, political, health and safety aspects, sustainable development as well as the development of the latest technology and advanced materials in the field of geophysical engineering.	
PLO-6	Able to apply procedural processes or components of geophysical engineering methods to create or modify models that utilize geological, geospatial, instrumentation and information technology data starting from identifying, formulating, analyzing and finding the source of problems, proposing the best solutions to solve problems, designing and operationalizing processes, processing systems and hardware and software equipment required in existing geophysical engineering designs, local, national resources and engineering design and analysis tools that are most appropriate, effective and efficient in solving complex geological and geophysical engineering problems in depth by taking into account legal, economic, environmental, socio-cultural, political, health factors , public safety, culture and sustainable development.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to explain the concept of geophysical methods in agriculture.	
CLO-2	Able to implement geophysical methods procedurally starting from data search, processing, subsurface geology and modeling to solve in-depth agricultural problems.	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C2,A3] Able to explain the concept of physical parameters in agricultural problems	
Sub CLO-2	[C2,A3] Able to explain the concepts and principles of geophysical methods in the agricultural sector	
Sub CLO-3	[C4,P3,A4] Able to implement geophysical methods in the agricultural sector	
Sub CLO-4	[C4,P3,A4] Able to integrate geophysical and GIS methods in the agricultural sector	

STUDY MATERIALS
• **Agricultural soil physical parameters**: soil texture, soil structure, quantitative relationship between soil parameters. • **General Considerations of Geophysical Methods for Agriculture**: resistivity, SP, electromagnetic, GPR and Seismic methods; aspects of agricultural geophysical data collection and analysis; potential agricultural uses for geophysical methods. • **Application of geophysical methods in agriculture**: Concept, survey design, data processing results and interpretation of geophysical methods for agriculture as well as integration of GPS and GIS with agricultural geophysics.
REQUIREMENTS
Geoelectric Exploration, Seismic Exploration, EGBM Exploration and EM Exploration
REFERENCES
1. Barry Allred, Jeffrey J. Daniels, and Mohammad Reza Ehzani (2008), Handbook of agricultural geophysics, Taylor & Francis Group 2. Neeru Mathur (2012), Handbook of agricultural geophysics, SBS Publisher, UK 3. Journals related to agriculture and geophysics for agriculture.

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM STUDY	
Course	**Course Name**	**On Job Training**
	Course Code	**CF234757**
	Credit	**9 (Nine)**
	Semester	**7 (Seven)**
COURSE DESCRIPTION		
Students carry out comprehensive and procedural research activities coveringidentify the source of the problem, formulate alternative solutions using geological and geophysical science and knowledge, analyze appropriate information and computing technology-based analysis in solving geophysical engineering problems. Students understandthe importance of developing professional competencies, knowing the latest developments - contemporary issues relevant to the development of earth science and technology through literature studies, applying science and technology in the context of developing lifelong learning and having a sustainable development perspective. Besides that,encourage students to think critically,internalized the ability to take responsibilityto the research process and results, discipline, internalizing academic values, norms and ethics for final project work as well as mastering information technology and effective communication techniques verbally and in writing based on scientific rules, procedures and ethics so that they can be of wider benefit to society.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-2	Able to study and utilize science and technology in order to apply it to the field of geophysical engineering, and be able to make appropriate decisions from the results of their own work or group work in the form of final project reports or other forms of learning activities whose output is equivalent to the final project through logical, critical thinking , systematic and innovative.	
PLO-3	Able to manage one's own learning, and develop oneself as a lifelong learner to compete at national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to sustainability principles and understanding technology-based entrepreneurship.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to apply basic science principles of geophysical engineering in identifying problem sources, formulating solutions, analyzing appropriate information and computing technology in completing the final assignment procedurally with the principles of benefit and sustainability.	
CLO-2	Able to make the right decisions and be responsible for the results of the final assignment and convey them using information technology and effective communication techniques orally and in writing.	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C4, P3, A3] Able to increase, broaden and strengthen students' skills in applying geophysical and non-geophysical exploration methods as a basic experience to enter the world of work in accordance with the study expertise they are undertaking, growing, developing and strengthening professional attitudes and as preparation beginning for the final task / thesis.	

Sub CLO-2	[C4, P3, A3] Able to organize data and present it again by utilizing information technology that suits their needs;
Sub CLO-3	[C4, P3, A3] Able to criticize complete operational procedures in solving geophysical engineering technology problems that have been and/or are being implemented, and expressed in the form of scientific working papers and presentations.
Sub CLO-4	[C4, P3, A3] Able to work together to make maximum use of their potential and be responsible for achieving work results.

STUDY MATERIALS

- Geological Exploration Methods
- Survey design, processing, and interpretation/analysis of geophysical exploration methods: Seismic Method, Gravity and Magnetic Method, Geoelectric Method, Electromagnetic Method
- Geotomography

REQUIREMENTS

Seismic Exploration, Geoelectric Exploration, Electromagnetic Exploration, Gravity and Magnetic Exploration, Inversion Method, Structural Geology, Geotomography

REFERENCES

1. Telford et al., Applied Geophysics, Cambridge Univ. Press, 1976
2. Reynolds, JM, An Introduction to applied and environmental Geophysics. John Wiley and Sons, 1997.
3. Sheriff, RE, and LP Geldart, Exploration Seismology. Cambridge Univ. Press, 1995.
4. Grant & West, Interpretation Theory in Applied Geophysics, Mc. Graw-Hill Book Company, 1965.3.
5. Billings, M.P., 1982, Structural Geology, Prentice Hall, New Delhi.
6. Indexed international and national journals.

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER FACULTY OF CIVIL PLANNING AND GEO ENGINEERING GEOPHYSICAL ENGINEERING DEPARTMENT UNDERGRADUATE PROGRAM (S1)	
Course	**Course Name**	**Final Project**
	Course Code	**CF234824**
	Credit (SKS)	**4 (Four)**
	Semester	**8 (Eight)**
COURSE DESCRIPTION		
Students carry out comprehensive and procedural research activities includingidentify the source of the problem, formulate alternative solutions using geological and geophysical science and knowledge, analyze appropriate information and computing technology-based analysis in solving geophysical engineering problems. Students understandthe importance of developing professional competencies, knowing the latest developments - contemporary issues relevant to the development of earth science and technology through literature studies, applying science and technology in the context of developing lifelong learning and having a sustainable development perspective. Besides that,encourage students to think critically,internalized the ability to take responsibilityon the research process and results, discipline, internalizing values, norms and academic ethics for final project work as well as mastering information technology and effective communication techniques verbally and in writing based on scientific rules, procedures and ethics so that they can be of wider benefit to society. This course is carried out based on the Final Assignment SOP and the recording of the activity process in the student's final assignment log book with the supervisor.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-2	Able to study and utilize science and technology in order to apply it to the field of geophysical engineering, and able to make appropriate decisions from the results of one's own work or group work in the form of a final assignment report or other form of learning activity whose output is equivalent to the final assignment through logical, critical thinking , systematic and innovative.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to apply basic science principles of geophysical engineering in identifying problem sources, formulating solutions, analyzing appropriate information and computing technology in completing the final assignment procedurally with the principles of benefit and sustainability.	
CLO-2	Able to make the right decisions and be responsible for the results of the final assignment and convey them using information technology and effective communication techniques orally and in writing.	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	[C4, P4, A4] Able to apply basic research concepts and conduct in-depth research on the procedural application of geophysical methods according to exploration stages (planning, acquisition, data processing, interpretation).	
Sub CLO-2	[C4, P4, A4] Able to organize data and evaluate research operational procedures.	
Sub CLO-3	[C4, P4, A4] Able to be responsible for the results of the final assignment in the form of a report	
Sub CLO-4	[C4, P4, A4] Able to be responsible for the results of the final assignment in the form of a scientific presentation.	
STUDY MATERIALS		
• Geological Exploration Methods • Survey design, processing, and interpretation/analysis of geophysical exploration methods: Seismic Method, Gravity and Magnetic Method, Geoelectric Method, Electromagnetic Method		

• Geotomography
PRECONDITION
Seismic Exploration, Geoelectric Exploration, Electromagnetic Exploration, Gravity and Magnetic Exploration, Inversion Method, Structural Geology, Geotomography
REFERENCES
1. Telford et al., Applied Geophysics, Cambridge Univ. Press, 1976 2. Reynolds, J.M., An Introduction to applied and environmental Geophysics. John Wiley and Sons, 1997. 3. Sheriff, RE, and LP Geldart, Exploration Seismology. Cambridge Univ. Press, 1995. 4. Grant & West, Interpretation Theory in Applied Geophysics, Mc. Graw-Hill Book Company, 1965.3. 5. Billings, M.P., 1982, Structural Geology, Prentice Hall, New Delhi. 6. Indexed international and national journals

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER	
Course	**Course Name**	**Islamic Studies**
	Course Code	**UG234901**
	Credit (SKS)	**2 (Two)**
	Semester	**6 (Six) / 7 (Seven)**
COURSE DESCRIPTION		
This Islamic Religious Education course discusses and explores material with the substance of human relations with Allah to create a generation of piety with the Qur'anic paradigm; human relations with fellow humans in order to integrate Faith, Islam and Ihsan; as well as human relations with their environment in order to ground Islam to realize prosperity. In this way, a religious, humanist, broad-minded and caring generation was born.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO-1	Faithful to God Almighty and able to show a religious attitude (S.1);	
PLO-2	Upholding human values in carrying out duties based on religion, morals and ethics (S.2);	
PLO-3	Internalize academic values, norms and ethics (S.8);	
PLO-4	Able to apply logical, critical, systematic and innovative thinking in the context of developing or implementing science and technology that pays attention to and applies humanities values in accordance with their field of expertise (KU.1)	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Applying the essence of human relations with Allah, with fellow humans and with the natural environment in the Qur'anic paradigm (KK.1);	
CLO-2	Skilled in presenting the results of conceptual and/or empirical studies related to the essence and urgency of Islamic spiritual values as one of the determinants in building a nation with character (KK.2);	
CLO-3	Skilled in acting consistently towards the coherence of the main principles of Islamic teachings as the implementation of Faith, Islam and Ihsan, as well as presenting Islam rahmatan lil alamin (KK.3);	
CLO-4	Understand the essence of Islamic Religious Education as a Compulsory Course component and its urgency as spiritual values which are one of the determinants in building national character (P.1);	
CLO-5	Understand the correlation between Islamic teachings and their contextualization in modern life as rahmatan lil alamin (P.3);	
CLO-6	Mastering the application of Islamic concepts regarding science, technology, social-humanities, and issues of people's welfare (P.4)	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	Applying the essence of human relations with Allah, with fellow humans and with the natural environment in the Qur'anic paradigm (KK.1);	
Sub CLO-2	Skilled in presenting the results of conceptual and/or empirical studies related to the essence and urgency of Islamic spiritual values as one of the determinants in building a nation with character (KK.2);	

Sub CLO-3	Skilled in acting consistently towards the coherence of the main principles of Islamic teachings as the implementation of Faith, Islam and Ihsan, as well as presenting Islam rahmatan lil alamin (KK.3);
Sub CLO-4	Understand the essence of Islamic Religious Education as a Compulsory Course component and its urgency as spiritual values which are one of the determinants in building national character (P.1);
Sub CLO-5	Understand the correlation between Islamic teachings and their contextualization in modern life as rahmatan lil alamin (P.3);
Sub CLO-6	Mastering the application of Islamic concepts regarding science, technology, social-humanities, and issues of people's welfare (P.4)

STUDY MATERIALS

1. Building a Qur'anic Paradigm
2. Human God as a Spiritual Need
3. Integration of Faith, Islam and Ihsan to Form Noble Morals
4. Religion Creates Happiness
5. Grounding Islam in Indonesia
6. Religious Moderation Creates Unity in Diversity
7. Islamic Philanthropy: Zakat, Alms and Waqf
8. Role and Function of Mosques for the Welfare of the Community
9. Islam Facing the Development of Science, Technology and Art
10. Contribution of Islam in the Development of World Civilization

PRECONDITION

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REFERENCES

1. Dirjen Pembelajaran dan Kemahasiswaan Kemenristekdikti. *Pendidikan Agama Islam untuk Perguruan Tinggi*, Jakarta, Dirjen Belmawa, 2016.
2. Wahyuddin, dkk. *Pendidikan Agama Islam Membangun Karakter Mahasiswa di Perguruan Tinggi*, Surabaya, Penerbit Litera Jannata Perkasa, 2019.
3. Muhibbin, Zainul, dkk. *Pendidikan Agama Islam Membangun Karakter Madani*, Surabaya, ITS Press, 2012.
4. Al Ghazali, Abu Hamid. (2011). *Ihya' 'Ulumiddin. Jeddah*: Dar al-Minhaj.
5. Hamka. *Tasawuf: Perkembangan dan Pemurniannya*. Jakarta: Pustaka Panji Mas, 1993.
6. Iberani, Jamal Syarif dkk. *Mengenal Islam*, Jakarta: eL-Kahfi, 2003.
7. Imarah, Muhammad. *Islam dan Pluralitas: Perbedaan dan Kemajemukan dalam Bingkai Persatuan*, Jakarta, Gema Insani, 1999
8. Qardhawi, Yusuf. *Karakteristik Islam*. Surabaya: Risalah Gusti, 1996.
9. Razaq, Nasruddin, *Dinnul Islam*, Bandung, Al-Ma,arif, 2005. Tebba, Sudirman. *Tasawuf Positif*. Jakarta: Prenada Media, 2003.
10. Zaenal Aushop, Asep. *Islamic Character Building, Membangun Insan Kamil Cendekia Berakhlak Qurani,* Bandung: Salamadani, 2014

COURSES	**Course Name**	:	**Christian Studies**
	Course Code	:	UG.234902
	Credits	:	**2 credits**
	Semester	:	**6/7**

DESCRIPTION OF COURSE

Christian religious education provides insight for students to develop a complete, strong personality based on Biblical Truth and living together and applying science and technology responsibly.

LEARNING OUTCOMES

1. *Devoted to the One Almighty God and capable of displaying a religious attitude*
2. *Maintaining the value of humanity while carrying out responsibilities based on religious, moral and ethical principles*
3. *Collaboration and social awareness, as well as concern for the community and the environment*
4. *Capable of maintaining and expanding collaboration networks, as well as the outcomes of such collaborations, both within and outside the organization*.

COURSE LEARNING OUTCOMES

1. The students have the capability to comprehend and accurately articulate the principles of Christianity.
2. The students grasp the true nature of humanity and the obligations that come with being devout believers.
3. The students have the ability to use the Word of God as the basis for their thoughts, words, and actions.
4. The students can put into practice the principles of Christianity in their social and civic lives
5. The students possess a sense of moral and legal consciousness in their interactions within society
6. The students exhibit a spirit of tolerance and are adept at promoting peaceful coexistence
7. The students understand the notion of science and technology from a Christian perspective and can harmoniously integrate their faith with their actions.
8. The students have the ability to distinguish between the principles of Christianity and cultural practices.
9. The students can embrace a democratic mindset and understand political discussions from the standpoint of Christian theology.
10. The students possess Christian values and are prepared to contribute to a post-modern society, effectively applying these principles in their real-life experiences

STUDY MATERIALS

1. The connection between religion and humanity.
2. The role of God in Christian faith.
3. The understanding of human beings according to Christian teachings.
4. Ethics' influence on shaping Christian character.
5. The correlation between Christian faith and science and technology.
6. Promoting harmony among different religions.
7. Being stewards of God's creation.
8. Christian community or fellowship.

PREREQUISITES

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REFERENCES

Main:
Kemenristekdikti. 2016. Pendidikan Agama Kristen Untuk Perguruan Tinggi. Jakarta: Dirjen Belmawa Kemenristekdikti
Daniel Nuhamara, dkk, 2016, "Pendidikan Agama Kristen untuk Perguruan Tinggi Umum", RISTEKDIKTI, Jakarta

Supporting

1. *Hans Kung, 1999, "Etika Global", Pustaka Pelajar, Yogyakarta.*
2. Henry C. Thiessen, 1995, "Teologi Sistimatika", Gandum Mas, Malang.
3. Herman Bavinck, 2011, "Dogmatika Reformed 1: Prolegomena", Momentum, Surabaya.
4. Herman Bavinck, 2011, "Dogmatika Reformed 2: Allah dan Penciptaan, Momentum, Surabya.
5. J. Verkuyl, 1992, "Etika Kristen Ras, Bangsa dan Negara", BPK Gunung Mulia, Jakarta.
6. J. Verkuyl, 1992, "Etika Kristen Bagian Umum", BPK Gunung Mulia, Jakarta.
7. John M. Frame, 2004, "Doktrin Pengetahuan Tentang Allah". Literatur SAAT, Malang.
8. K. Bertens, 2011, "Etika", Gramedia, Jakarta.
9. Kenneth Richard Samples, 2015, "Without a Doubt, Literatur", SAAT, Malang.
10. Millard J. Erickson, 1999, "Teologi Kristen", Gandum Mas, Malang.
11. Norman L. Geisler, 2015, "Etika Kristen" Literatur SAAT, Malang.
12. Norman L. Geisler & Frank Turek, 2016, "I Don't Enough Faith To Be An Atheis", Literatur SAAT, Malang.
13. Paul Enns, 2008, "The Moody Handbook of Theology", Literatur SAAT, Malang
14. R. C. Sproul, 2012, "Kebenaran-Kebenaran Dasar Iman Kristen", Literatur SAAT, Malang.

COURSES	***Course Name***	:	***Chatolic studies***
	Course Code	:	UG.234903
	Credit	:	**2 credits**
	Semester	:	**6/7**

DESCRIPTION OF COURSE

Students can explain the nature of humans as religious beings with faith and piety, apply moral behavior, and use the teachings of the Catholic Religion as a foundation for thinking and behaving in their work according to their field of expertise, both in individual and teamwork performance .

LEARNING OUTCOMES

1. Devoted to the One Almighty God and capable of displaying a religious attitude
2. Maintaining the value of humanity while carrying out responsibilities based on religious, moral and ethical principles
3. Collaboration and social awareness, as well as concern for the community and the environment
4. Capable of maintaining and expanding collaboration networks, as well as the outcomes of such collaborations, both within and outside the organization.

COURSE LEARNING OUTCOMES

1. Students understand the significance of Catholic Religious Education in Higher Education
2. Students are capable of expressing the fundamental principles of the Triune divinity concept in accordance with Catholic teachings.
3. Students are able to summarize and provide examples of the relationship between Tradition and Scripture in the Catholic Church, as well as the relationship between Scripture and Science, and to demonstrate that Scripture and Science are not contradictory.
4. Students are able to demonstrate with concrete examples the actions that result from the concepts of atheism, relativism, syncretism, permissivism, and radicalism in people's lives, as well as describe and provide arguments that Catholic marriage is monogamous and cannot be divorced.
5. Students can select and determine case study topics in a systematic, quality, and measurable manner, as well as formulate case study problems using valid reference sources.
6. Students can professionally gather and organize the outcomes of case studies and collaboratively present them in a manner that is both substantial and measurable, offering compelling arguments rooted in Catholic teachings to support their findings.

STUDY MATERIALS

1. The Calling of Humanity according to the Scriptures
2. Human Relationships with Self, Others, the Environment, and God
3. Nurturing Faith in the Midst of Plurality
4. The Works of Jesus Christ and the Kingdom of God
5. The Church in the Context of Society
6. Christian Ethics

PREREQUISITES

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REFERENCES

Main:
Kemenristekdikti. 2016. Pendidikan Agama Katolik Untuk Perguruan Tinggi. Jakarta: Dirjen Belmawa Kemenristekdikti

Supporting:

1. Konferensi WaliGereja Indonesia. ***Katekismus Gereja Katolik*** [cetakan 8]. Jakarta: KWI & Kanisius, 2013
2. Achmad, N. ***Pluralisme Agama, Kerukunan dalam Keragaman***. Jakarta: Penerbit Buku Kompas, 2001.
3. Barbour, Ian G. ***Juru Bicara Tuhan antara Sains dan Agama***. Bandung: Penerbit Mizan, 2000.
4. Griffin, David Ray. ***Tuhan dan Agama dalam Dunia Post Modern***. Yogyakarta: Kanisius, 2005.
5. Ismartono, SJ, I. ***Kuliah Agama Katolik Di Perguruan Tinggi Umum***. Jakarta: Obor, 1993.
6. Sugiarto. I. Bambang. ***Agama Menghadapi Jaman***. Jakarta: APTIK, 1992.
7. Leahy Louis. ***Filsafat Ketuhanan Kontemporer***. Yogyakarta: Kanisius & BPK Gunung Mulia, 1994

COURSES	**Course Name**	:	**Hindu studies**
	Course Code	:	U.G. 234904
	Credit / Credits	:	**2 credits**
	Semester	:	**6/7**

DESCRIPTION OF COURSE

The Hindu religion course discusses and explores materials with the substance of human relations with Hyang Widdhi (God Almighty) for increased faith and Taqwa (Sraddha and bhakti); human relations with fellow humans in building a humanist civilization; as well as human relations with their environment in creating welfare (jagadhita), so as to be able to form Hindu and Indonesian human beings who are independent, responsible and caring.

LEARNING OUTCOMES

1. Have faith in God Almighty and be able to show a religious attitude
2. Upholding human values in carrying out duties based on religion, morals and ethics
3. Being cooperative and having social sensitivity and concern for society and the environment
4. Being able to maintain and develop cooperative networks and cooperative results within and outside the institution

COURSE LEARNING OUTCOMES

1. Able to explain the philosophy (Tattwa) of Hinduism in building sraddha and devotion (faith and piety) to God Almighty (Sanghyang Widdhi Wasa) to form religious attitudes
2. Able to implement Hindu Ethics to uphold human values in forming honest, law-abiding, creative, healthy and adaptive personalities
3. Able to believe in the values of the program to improve Hindu morality and spirituality
4. Able to project Hindu values in global association

STUDY *MATERIALS*

1. History of Hinduism
2. Brahmavidya/Hindu Theology
3. Veda
4. Humans in Hindu perspective
5. Hindu ethics/morals
6. Yadnya
7. Religious art
8. Harmony
9. Deradicalization in Hindu perspective

PREREQUISITES

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REFERENCES

Main:

Direktorat Jenderal Pembelajaran dan Kemahasiswaan, 2016, Pendidikan Agama Hindu untuk Perguruan Tinggi, Kemenristek Dikti RI

Supporting:

1. Singer, Wayan, 2012. Tattwa (Ajaran Ketuhanan Agama Hindu, Surabaya, Paramita
2. Tim Penyusun, 1997, Pendidikan Agama Hindu Untuk Perguruan Tinggi, Hanuman Sakti
3. Wiana, 1994, Bagaimana Hindu Menghayati Tuhan, Manikgeni .
4. Wiana, 1982, Niti Sastra, Ditjen Hindu dan Budha.
5. Titib, 1996, Veda Sabda Suci Pedoman Praktis Kehidupan, Paramita.
6. Pudja, 1997, Teologi Hindu, Mayasari
7. Surpa,Wayan,2015, Hakikat Dan Martabat Manusia Dalam Agama Hindu Dan Norma-norma yang Ada Di Dalam Masyarakat Indonesia,UPT. PPKB. UNUD,
8. Kementrian Agama RI, 2019, Moderasi Beragama, Badan Litbang dan Diklat Kementrian RI

COURSES	**Course Name**	:	**Buddhis Studies**
	Course Code	:	UG.234905
	Credits	:	**2 credits**
	Semester	:	**6/7**

DESCRIPTION OF COURSE

Buddhist education imparts students with the wisdom to cultivate a holistic and resilient character, rooted in the teachings of the Tripitaka Scriptures and communal utilization of living, while also encouraging responsible science and technology.

LEARNING OUTCOMES

1. Devoted to the One Almighty God and capable of displaying a religious attitude
2. Maintaining the value of humanity while carrying out responsibilities based on religious, moral and ethical principles
3. Collaboration and social awareness, as well as concern for the community and the environment
4. Capable of maintaining and expanding collaboration networks, as well as the outcomes of such collaborations, both within and outside the organization.

COURSE LEARNING OUTCOMES

1. Students understand the significance of Buddhist Religious Education in Higher Education
2. Students can select and determine case study topics in a systematic, quality, and measurable manner, as well as formulate case study problems using valid reference sources.
3. Students can professionally gather and organize the outcomes of case studies and collaboratively present them in a manner that is both substantial and measurable, offering compelling arguments rooted in Buddhist teachings to support their findings.

STUDY MATERIALS

1. The Tipitaka/Tripitaka Texts
2. Philosophy and History of Buddhist and Human Life Meaning
3. Buddhism's laws are universal.
4. The Buddhist Concept and Meaning of the ONE ALMIGHTY GOD
5. Moral values as guiding principles in human existence (Sila)
6. Buddhism's perspective on science and technology in human existence.
7. The Buddhist society concept and inter-religious peace.
8. The Meaning and Importance of Buddhist Cultural and Political Dynamics in the National Context

PREREQUISITES

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REFERENCES
Main: Kemenristekdikti. 2016. Pendidikan Agama Buddha Untuk Perguruan Tinggi. Jakarta: Dirjen Belmawa Kemenristekdikti
***Supporting*:** 1. Kitab Suci Dhammapada *2.* Perdebatan Raja Milinda (ringkasan Milinda Panha oleh Bhiku Pesala Sangha Theravada Indonesia

COURSES	**Course Name**	:	**Khonghucu studies**
	Course Code	:	UG.234906
	Credit	:	**2 credits**
	Semester	:	**6/7**

DESCRIPTION OF COURSE

This Confucian Religion study discusses the Ru-Confucian religion as a Religious Philosophical religion and seeks an understanding of the scriptures, the purpose of life and after life, the activities that should be carried out in an effort to live life as a Junzi, how the creation of the universe and humans and their relationship to the nature of existence. as human beings, suffering, trials and disasters, divinity and faith in the Ru-Confucian religion, Prophets and Prophets, Shenming and gods and their relation to houses of worship, worship and religious holidays and the basic values ??contained therein, which are not apart from studies based on the concept of yin-yang, Tian Di Ren and history are expected to encourage clergy and students to have faith and moral ethics that are applied in daily life because of their belief that only Virtue is acceptable before TIAN. With this learning, the clerics (lecturers) understand that to achieve their true goals as human beings and guide students to understand their goals and achieve their true goals as human beings, a conscious and faith-filled effort is needed to apply the Religious and Philosophical values ??of the Ru-Confucian religion in physical life. and spiritual.. a conscious and faith-filled effort is needed to apply the Religious and Philosophical values ??of the Ru-Confucian religion in physical life. and spiritual.. a conscious and faith-filled effort is needed to apply the Religious and Philosophical values ??of the Ru-Confucian religion in physical life. and spiritual.

LEARNING OUTCOMES

1. Devoted to the One Almighty God and capable of displaying a religious attitude
2. Maintaining the value of humanity while carrying out responsibilities based on religious, moral and ethical principles
3. Collaboration and social awareness, as well as concern for the community and the environment
4. Capable of maintaining and expanding collaboration networks, as well as the outcomes of such collaborations, both within and outside the organization.

COURSE LEARNING OUTCOMES

1. Comprehending the principles of Confucian Philosophy in fostering belief and devotion to the Supreme Deity
2. Grasping the essence of Confucian Ethics to prioritize human values in molding an individual's character marked by honesty, law-abidance, creativity, well-being, and adaptability.
3. Utilizing Confucian Ritual Values to elevate the moral and spiritual aspects of Confucian beliefs.
4. Capable of manifesting Confucian values in a global context.

STUDY MATERIALS
1. Ru-Confucianism 2. Purpose of Human Life 3. The Creation of the Universe and Man 4. Divinity 5. Prophet 6. Shen Ming 7. Places of Worship, Religious Holidays 8. Principles of Faith 9. Study, Pray and Jing-Zuo 10. Principles of Moral and Ethical Teachings
PREREQUISITES
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REFERENCES
Main: Kemenristekdikti. 2016. Pendidikan Agama Konghucu Untuk Perguruan Tinggi. Jakarta: Dirjen Belmawa Kemenristekdikti
***Supporting*:** 1. Xs. Tjhie Tjay Ing dkk, Hidup Bahagia dalam Jalan Suci Tian, Gerbang Kebajikan Ru, 2010 2. Yu Dan, 1000 Hati Satu Hati, Gerbang Kebajikan Ru, 2009

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER	
Course	**Course Name**	**Pancasila**
	Course Code	**UG234911**
	Credit	**2 (Two)**
	Semester	**6 (Six) / 7 (Seven)**
COURSE DESCRIPTION		
Character is the primary pillar in the development of a nation's civilization. In this development effort, efforts are required to establish Pancasila's essential ideals as the philosophy and way of life of the Indonesian people. In this course, students will be invited to investigate and understand the Indonesian nation's identity using Pancasila content from the country's recent past. Then, recognize Pancasila's strategic functions as a noble agreement, the foundation of the state, philosophy and ideology of the nation, and finally, implement Pancasila in the growth of science and technology. Case studies, group discussions, and project-based learning will all be employed as teaching strategies in this course. Students will be encouraged to investigate topics provided in journals, on the internet, or in movies in order to develop their critical thinking and discussion skills. At the conclusion of the meeting, students must demonstrate their ability to work in groups by creating a final project based on the assigned theme. In order to create a sense of nationalism and be able to actively participate in development initiatives in the fields of science and technology, students are anticipated to be able to gain a basic understanding of the fundamental philosophy of the Indonesian people through this course.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO 1	Able to demonstrate attitudes and characters that reflect: being pious to God Almighty, having ethics and integrity, virtuous character, sensitive and concerned with social and environmental issues, respecting cultural differences and pluralism, upholding law enforcement, prioritizing the interests of the nation and the wider community, through creativity and innovation, excellence, strong leadership, synergy, and other potentials to achieve maximum results.	
PLO 3	Able to manage self-learning and develop oneself as a lifelong learner to compete at national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to sustainability principles and understanding technology-based entrepreneurship.	
COURSE LEARNING OUTCOMES (CLO)		
CPMK 1	Able to study the values of Pancasila in its application in the life of the nation and state	
CPMK 2	Able to understand the implementation of Pancasila as a basic philosophy and outlook on life as a reference for the attitude of life as a nation and state	
CPMK 3	Able to analyze the development of science and technology in the era of the Industrial Revolution 4.0 based on Pancasila values	
CPMK 4	Able to practice social sensitivity, environmental care and love for the homeland	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	Able to study the values of Pancasila in its application in the life of the nation and state	

Sub CLO-2	Able to understand the implementation of Pancasila as a basic philosophy and outlook on life as a reference for the attitude of life as a nation and state
Sub CLO-3	Able to analyze the development of science and technology in the era of the Industrial Revolution 4.0 based on Pancasila values
Sub CLO-4	Able to practice social sensitivity, environmental care and love for the homeland

STUDY MATERIALS

1. The urgency of Pancasila in higher education
2. The history of Pacnasila
3. Pancasila as the Indonesia national principle and national ideology
4. Pancasila as philosophy system
5. Pancasila as ethic system
6. Pancasila as the foundation of science, technology and art development

PRECONDITION

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REFERENCES

1. Kemenristekdikti. 2016. *Pendidikan Pancasila Untuk Perguruan Tinggi.* Jakarta: Dirjen Belmawa Kementerian Dikti
2. Bahar, Saafroedin (ed). 1992. *Risalah Sidang Badan Penyelidik Usaha-Usaha Persiapan Kemerdekaan Indonesia (BPUPKI): Panitia Persiapan Kemerdekaan Indonesia (PPKI) 29 Mei – 19 Agustus 1945*. Jakarta: Sekretariat Negara Republik Indonesia.
3. Bertens, Kees. 2004. *Etika.* Jakarta: Gramedia.
4. Kattsof, Louis O. 1992. *Pengantar Filsafat.* Yogyakarta: Tiara Wacana.
5. Latif, Yudi. 2011. *Negara Paripurna*, Jakarta: PT. Gramedia Pustaka Utama.
6. Latif, Yudi. 2018. *Wawasan Pancasila: Bintang Penuntun Untuk Pembudayaan.* Jakarta: Mizan.
7. Magnis-Suseno, Franz. 2006. *Etika Politik: Prinsip-prinsip Moral Dasar Kenegaraan Modern*. Jakarta: Penerbit Gramedia Pustaka Utama.
8. Sukarno. 2001. *Tjamkan Pancasila Dasar Falsafah Negara*. Jakarta: Panitia Nasional Peringatan Lahirnya Pancasila 1 Juni 1945 – 1 Juni 1964.
9. Soedarso. 2014. *Filsafat Pancasila Identitas Indonesia*. Surabaya: Pustaka Radja.

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER	
Course	**Course Name**	**Indonesian**
	Course Code	**UG234912**
	Credit (SKS)	**2 (Two)**
	Semester	**6 (Six) / 7 (Seven)**
COURSE DESCRIPTION		
The Indonesian language course is one of the general / national compulsory courses, therefore students will explore lecture materials including: (a) academic ethics; (b) referencing techniques; (c) Systematics of Scientific Writing (KTI) and Indonesian language formulations used in KTI with due observation of grammar, PUEBI, and KBBI principles; (d) structuring KTI logically, critically, systematically, and innovatively by using good and correct Indonesian; (e) effective presentation techniques. The material studied is useful in compiling scientific papers in the form of lecture assignments, research reports, as well as competing scientific papers		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO 1	Able to demonstrate attitudes and characters that reflect: being pious to God Almighty, having ethics and integrity, virtuous character, sensitive and concerned with social and environmental issues, respecting cultural differences and pluralism, upholding law enforcement, prioritizing the interests of the nation and the wider community, through creativity and innovation, excellence, strong leadership, synergy, and other potentials to achieve maximum results.	
PLO 3	Able to manage self-learning and develop oneself as a lifelong learner to compete at national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to sustainability principles and understanding technology-based entrepreneurship.	
COURSE LEARNING OUTCOMES (CLO)		
CLO 1	Able toexplain concepts and benefits of understanding the application of academic ethics correctly.	
CLO 2	Able to apply reference and citation techniques appropriately.	
CLO 3	Able to explain the systematics and formulations of Indonesian used in KTI by paying attention to the rules of grammar, PUEBI, and KBBI.	
CLO 4	Able to compile well scientific papers and introduction as a form of logical, critical, systematic, and innovative logical thinking ability using good and correct Indonesian.	
CP MK 5	Able to present the results of the preparation of KTI properly according to the principles of effective communication.	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO 1	Able toexplain concepts and benefits of understanding the application of academic ethics correctly.	
Sub CLO 2	Able to apply reference and citation techniques appropriately.	
Sub CLO 3	Able to explain the systematics and formulations of Indonesian used in KTI by paying attention to the rules of grammar, PUEBI, and KBBI.	

Sub CLO 4	Able to compile well scientific papers and introduction as a form of logical, critical, systematic, and innovative logical thinking ability using good and correct Indonesian.
Sub CLO 5	Able to present the results of the preparation of KTI properly according to the principles of effective communication.

STUDY MATERIALS

1. Academic writing of scientific papers.
2. Reference techniques and Mendeley applications for reference systems.
3. Systematics, writing style, and grammatical rules for the Indonesian language in KTI.
4. Effective presentation.

PRECONDITION

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REFERENCES

1. Alwi, Hasan, 2007, Standard Indonesian Grammar, Third Edition, Balai Pustaka: Jakarta.
2. Director General of Learning and Student Affairs, Ministry of Research, Technology and Higher Education, Indonesian Language for Higher Education, 2016, Jakarta, Director General Belmawa.
3. *Indonesia Dictionary*(online or offline), Indonesian Ministry of Education and Culture,https://kbbi.kemdikbud.go.id/
4. *General Guidelines for Indonesian Spelling*(PUEBI), 2022,https://puebi.js.org/
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COURSE		
	Course Name	**: Civics**
	MK Code	**: UG 234913**
	Credit	**: 2 credits**
	Semester	**: 6 / 7**

COURSE DESCRIPTION

Learning Citizenship is basically learning about Indonesianness, learning to become human beings with Indonesian personality, building a sense of nationality, respecting pluralism, upholding just law enforcement and loving the Indonesian homeland. To become a good Indonesian citizen, one must understand Indonesianness, have a sense of nationality and love for the Indonesian homeland, so that one can become a good and educated citizen (smart and good citizen) in a democratic society, nation and state based on Pancasila and the 1945 Constitution.

PROGRAM LEARNING OUTCOMES

1. PLO1: Able to demonstrate attitudes and characters that reflect: being pious to God Almighty, having ethics and integrity, virtuous character, sensitive and concerned with social and environmental issues, respecting cultural differences and pluralism, upholding law enforcement, prioritizing the interests of the nation and the wider community, through creativity and innovation, excellence, strong leadership, synergy, and other potentials to achieve maximum results.

2. PLO3: Able to manage self-learning and develop oneself as a lifelong learner to compete at national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to sustainability principles and understanding technology-based entrepreneurship.

COURSE LEARNING OUTCOMES

CLO1:
Able to understand the concept of smart and good citizenship based on Pancasila and the 1945 Constitution

CLO2:
Able to apply attitudes and values as citizens who have Indonesian personality, have disciplined competitiveness and actively participate in building the life of the Republic of Indonesia based on Pancasila.

CLO3:
Able to analyze the attitudes and values of citizens who comply with the implementation of law in Indonesia

CLO4:
Able to assess and criticize in order to solve problems by implementing information and communication technology, with the principles of sustainability and technology-based entrepreneurship.

STUDY MATERIALS

1.The nature and challenges of citizenship for the future of the nation
2. National Identity
3. National Integration
4. State and Constitution
5. Harmony of Obligations and Rights of the State and Citizens and Human Rights
6. Indonesian democracy
7. Equitable Law Enforcement

8. Archipelagic Outlook and Regional Autonomy
9. National Defense and State Defense
10. Anti-Corruption Education

PRECONDITION

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REFERENCES

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2. Azyumardi Azra, New Paradigm of National Education and Reconstruction and Democratization, Kompas Publishers, Jakarta, 2002
3. Bahar, Dr. Saefrodin, "State Context, Human Rights, Sinar Harapan Library, Jakarta, 2000.
4. Kaelan, Citizenship Education, UGM Press, Yogyakarta 2005.
5. Slamet Soemiarno, Indonesian Geopolitics, Jakarta, Directorate General of Higher Education, 2006
6. Guide to Inserting Anti-Corruption Education in Citizenship Education Courses, KPK, 2019

COURSE	**Course Name**	**: English**
	Course Code	**: UG234914**
	Credit	**: 2 credits**
	Semester	**: 6 or 7**

COURSE DESCRIPTION

The English course as a characteristic course for ITS is designed to help students integrate English language skills to meet academic and linguistic needs in the world of work.

LEARNING OUTCOMES OF GRADUATES CHARGED BY COURSES

Attitude: Able to demonstrate attitudes and character that reflect: devotion to God Almighty, noble character, sensitive and concerned about social and environmental problems, respecting cultural differences and pluralism, upholding law enforcement, prioritizing the interests of the nation and wider community, through innovation , creativity and other potential.

KU: Able to manage one's own learning, and develop oneself as a person
lifelong learners to compete at national and international levels, in order to make a real contribution to solving problems by paying attention to the principles of sustainability.

COURSE LEARNING OUTCOMES

1. Students are able to analyze texts by applying reading strategies effectively.
2. Students are able to write five paragraph essays by applying the essay writing structure correctly.
3. Students are able to make academic presentations by applying presentation techniques correctly.
4. Students are able to integrate language skills for academic needs and preparation for the world of work.

STUDY MATERIALS

1. Reading Strategies: Skimming, Scanning, Reading for detailed comprehension
2. Vocabulary in context
3. Text Organization/text structure
4. Signal words for text organization
5. Sentence Structure
6. Paragraphs
7. Writing Process
8. Essay Writing
9. The Structure of an Essay
10. Writing an Essay
11. References
12. Citations
13. Academic Presentations
14. Planning: Establishing the context
15. Structuring Your Presentation
16. Using Visual Aids
17. Delivering your speech
18. English for Workplace
19. Addressing Selection Criteria
20. Writing Your CV/Resume
21. Writing Your Application
22. At The Interview

PRECONDITION

- There isn't any

REFERENCES

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6. Weissman Jerry, 2006, “Presenting to Win, the Art of Telling Your Story, Prentice Hall.
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8. Barbara Chivers and Michael Shoolbred, 2007, Student's Guide to Presentations, Making Your Presentation Count, SAGE Publication.
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SUPPORTING LITERATURE

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2. Root Christine & Blanchard Karen, “Ready to Write, Pearson Education, New York, 2003
3. Bonamy David, “Technical English,” Pearson Education, New York, 2011
4. Fellag Linda Robinson, “College Reading,” Houghton Mifflin Company, 2006
5. Fuchs Marjorie & Bonner Margaret, “ Focus on Grammar; An Integrated Skills Approach,” Pearson Education, Inc, 2006
6. Hague Ann, “First Steps in Academic Writing,” Addison Wesley Publishing Company, 1996

	INSTITUT TEKNOLOGI SEPULUH NOPEMBER	
COURSE	**Course Name**	**Technopreneurship**
	Course Code	**UG234915**
	Credit	**2 (Two)**
	Semester	**6 (Six)**
COURSE DESCRIPTION		
This course provides students with the understanding and skills to be able to identify and evaluate technology-based business opportunities according to the student's field of expertise, as well as being able to develop business opportunities using Digital Marketing (Artificial Intelligence). This course combines an integrated introduction to theory and direct practice (hands-on experience) in developing business ideas and opportunities. In the end, students are expected to be able to express business opportunities in the form of prototypes or products that are ready to be sold and effective business plans as a team to be exhibited at the end of the course.		
PROGRAM LEARNING OUTCOMES (PLO)		
PLO 1	Able to demonstrate attitudes and character that reflect: devotion to God Almighty, ethics and integrity, noble character, sensitivity and care for social and environmental problems, respecting cultural differences and pluralism, upholding law enforcement prioritizing the interests of the nation and wider community, through creativity and innovation, excellence, strong leadership, synergy, and other potential to achieve maximum results.	
PLO 3	Able to manage one's own learning, and develop oneself as a lifelong learner to compete at national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to sustainability principles and understanding technology-based entrepreneurship.	
COURSE LEARNING OUTCOMES (CLO)		
CLO-1	Able to adapt to the situation faced and survive in uncertain conditions by carrying out appropriate feasibility analysis calculations.	
CLO-2	Able to innovate and be creative to produce market-oriented technology-based product designs (prototypes) by utilizing Artificial Intelligence.	
CLO-3	Able to prepare business plan proposals that are attractive and persuasive to investors.	
CLO-4	Able to formulate a Digital Marketing model.	
CLO-5	Formulate needs for HR aspects andoperational aspectsbased on the stages which are realized in the simulation to build a sense of team responsibility that prioritizes business ethics.	
CLO-6	Able to prepare financial plans in business proposals.	
CLO-7	Able to create simple web content and optimize simple web pages.	
SUB COURSE LEARNING OUTCOMES (SUB CLO)		
Sub CLO-1	Able to adapt to the situation faced and survive in uncertain conditions by carrying out appropriate feasibility analysis calculations.	
Sub CLO-2	Able to innovate and be creative to produce market-oriented technology-based product designs (prototypes) by utilizing Artificial Intelligence.	

Sub CLO-3	Able to prepare business plan proposals that are attractive and persuasive to investors.
Sub CLO-4	Able to formulate a Digital Marketing model.
Sub CLO-5	Formulate needs for HR aspects andoperational aspectsbased on the stages which are realized in the simulation to build a sense of team responsibility that prioritizes business ethics.
Sub CLO-6	Able to prepare financial plans in business proposals.
Sub CLO-7	Able to create simple web content and optimize simple web pages.

STUDY MATERIALS

1. Technopreneur and Business
2. Recognizing Opportunities and Creating Business Ideas using Artificial Intelligence
3. Business Opportunity Feasibility Analysis
4. Developing an effective Business Model
5. *Digital Marketing & Marketing Funnel*
6. Create a Simple Google My Business Website
7. Operational and HR Management
8. Financial management

PRECONDITION

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REFERENCES

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4. William, B. K., Sawyer, S. C., Berston, S., (2013). Business: A Practical Introduction. Upper Saddle River, N.J: Prentice Hall
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COURSE		
	Course Name	**: Applied Technology and Digital Transformation**
	Course Code	**:UG234916**
	Credit	**: 3 credits**
	Semester	**: 6 / 7**

COURSE DESCRIPTION

The Technology Applications and Digital Transformation (APTEKTRANSIDI) course is one of the Institute's mandatory courses. This course is a characteristic of ITS, which will provide inspiration to students in developing competitive insights into science, technology and innovative products as well as their application in society and the environment. Students will receive material 1)Digital Literacy Knowledge and Concepts; 2) Systems Theory and Systemic Thinking; 3) Introduction to Artificial Intelligence and Science Technopark (STP) Technology; 4) Knowledge of the National Research Roadmap and ITS; 5) Knowledge and Concept of Sustainable Development Goals (SDGs); 6) Creative and Innovative Knowledge; 7) Opensource Mobile Application Technology, E Commerce; and 8) ManufacturingProposal for the Student Creativity Program (PKM) and similar programs in preparing project-based innovation along with PKM Proposal Output (Articles and Videos).So thatAt the end of this course, students are able to prepare a Student Creativity Program Proposal (PKM) based on the knowledge provided in this lecture. The benefits of studying the APTEKTRANSIDI course are: Students are able to explain, explain and implement problems in society and the environment using a technology application approach and expertise in their field in accordance with the principles in the APTEKTRANSIDI teaching material.

PROGRAM LEARNING OUTCOMES

PLO	PLO Description
PLO 1	Able to show attitudes and character that reflect: devotion to Almighty God, ethics and integrity, noble character, sensitive and caring about social and environmental problems, respecting cultural differences and pluralism, upholding law enforcement, prioritizing interests nation and society at large, through creativity and innovation, excellence, strong leadership, synergy and other potential to achieve maximum results.
PLO 3	Able to manage one's own learning, and develop oneself as a lifelong learner to compete at national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to sustainability principles and understanding technology-based entrepreneurship.

COURSE LEARNING OUTCOMES

CLO	CLO Description
CLO 1	Students understand the outline of the lecture from start to finish, are able understand the Knowledge and Concepts of Digital Literacy by thinking systematic in solving general problems well and correctly
CLO 2	Students are able to utilize research centers both locally and nationally v competitive technological applications and innovative products
CLO 3	Able to have insight into conservation of natural and human resources in apply science and technology for the benefit of Sustainable Development with SDG's The and Concepts.
CLO 4	Able to complete the preparation of Student Creativity Program Proposals (PKM) similar programs in preparing project-based innovation along with PKM Propo Outputs (Articles, Posters and Videos).

STUDY MATERIALS

The material for the Technology Applications and Digital Transformation course is

1. Digital Literacy Knowledge and Concepts
2. Systems Thinking Theory and Information Transformation
3. Introduction to Artificial Intelligence and Science Technopark (STP) Knowledge
4. Knowledge of ITS and National Research Roadmap
5. Innovative Creative Knowledge
6. SDGs (Sustainable Development Goals) concept
7. Open Source Technology and IT Ethics
8. Student Creative Program Proposal Concept (PKM)

PRECONDITION

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